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MOTIVE-POWER FROM ELECTRICITY.

Although the idea of obtaining motive-power by the application of electricity is very old, and notwithstanding the fact that we possess at the present time such means of producing powerful currents as were quite unknown to the bygone race of electricians, yet the matter does not seem to have so much attention concentrated upon its ultimate solution now as it formerly did. This seeming want of interest is, no doubt, chiefly accounted for by the superior attractiveness, for the moment, of the electric light, so it is scarcely to be wondered at that the electric-motor is being worked upon by comparatively few. Had our predecessors possessed the dynamo-electric machines of our day, the problem of reducing to a practical and economical end the latent power of the waste forces of nature would have been solved. We must not, however, lose sight of what has been done by Messrs. Siemens and others of late years towards the practical development and use of electric railways; but the distribution of electric force for light work, such as actuating small lathes, &c., does not appear to have yet arrived at any definite solution. It has been stated over and over again what a boon such an application of electricity would be to the numberless workmen privately engaged in the mechanical trades, and who cannot afford to erect a steam-engine and boiler to supply their motive-power. Such a desirable method of securing an invisible but powerful ally cannot, however, fall to the lot of the British workman until, as in the case of electric lighting, central stations are established for electrical distribution on a large scale. Almost without exception electric lighting companies have the word "power" attached to their titles, yet we cannot call to mind a single instance of the application of electricity for such a purpose by any one company. It is somewhat surprising that an association has not yet been formed in England for supplying motive-power solely. With machines which will reproduce at a distance 60 per cent. of the horse-power developed by the driving engine, surely a profitable business might be insured to any company based on such a project, and we feel convinced that the venture would meet with the most favourable support.

The late Electrical Exhibition held in Paris gave sufficient evidence that such an idea is quite practicable, and it may be that the forthcoming exhibits at the Crystal Palace and the Royal Aquarium may produce something novel in this direction. Although private householders might not at first be induced to "rent" electricity for the purpose of driving the family sewing machine, yet there are innumerable instances of manufacturers employing dozens of these useful domestic articles who would certainly be well content to use electric power for the benefit of themselves and the operatives, who cannot but experience great fatigue in driving such machines throughout the long hours to which they are usually subjected. A company formed for this object would not be under the necessity of purchasing patents, as there are several good and simple motors which are free to every one, and the dynamo-electric machines can be obtained from numerous firms. Such extraordinary speculation has been indulged in during the present year, in connection with electrical matters, that we believe the public would strongly support a genuine movement for the general supply of electric power if kept free from electric lighting altogether. It is probable that the most successful start could be made in certain provincial towns rather than in the metropolis, but in either case the scheme appears perfectly feasible.

TESTING BATTERIES OF LOW RESISTANCE.

By H. R. KEMPE.

The practical difficulties which are found to exist in carrying out the ordinary battery resistance tests, when these tests are applied to the measurement of batteries or accumulators of low resistance, are being continually experienced; some method, therefore, of overcoming these difficulties may prove useful. One fruitful source of error is no doubt imperfect connections from the terminals of the various cells not being properly cleaned or screwed up, whilst the resistance of the connecting wires themselves may introduce an error which cannot be ignored when the resistance of the cells is excessively small; for instance, the resistance of a single cell of an accumulator may be as low as ·001 ohm, that is about the resistance, of 12 inches of copper wire of No. 13 B.W.G. or 1-10th in. diameter. Supposing, however, that the proper precautions have been taken so as to avoid such errors as the foregoing we are confronted with other difficulties. It is pretty generally known by those who have had to make practical measurements that in order to take battery tests with anything like accuracy, it is necessary that one measurement be made with the battery connected to a resistance approximately equivalent to the resistance of the battery itself; thus in the well-known "half deflection" method we first connect the battery to a galvanometer of very low (and consequently negligible) resistance, and then having noted the deflection, we introduce into the circuit a resistance sufficient to reduce the deflection to that point which indicates that the current flowing in the circuit has been halved in strength; when this is the case the resistance added in the circuit is the resistance of the battery. Instead of reducing the current to one-half strength, it is sufficient to introduce sufficient resistance in the circuit to produce a decided diminution in the deflection, and then from the true deflections observed, and the resistance added in the circuit, the resistance of the battery can be determined by a simple formula. Another well-known method is to charge a condenser from the battery, and then to note the discharge; a second discharge is then taken with the battery shunted, and then the resistance of the battery is determined by a simple formula. Now, in order that any of these methods may be accurate, it is very necessary that the reduced deflection be a decided one. For instance, if the first deflection (on a Thomson's galvanometer, say) be 200 divisions, then the reduced deflection should not be less than 150 divisions, and preferably it should be as near to 100 divisions as possible. Assuming, however, that 150 divisions is sufficient, then this will mean that the battery is shunted by a resistance equal to three times the resistance of the battery. Now, supposing we tried to test a single cell of an accumulator having a resistance of ·001 ohm by this method, then when the shunt is inserted we should have a current flowing through the latter equal to

$$\frac{2 \text{ volts}}{\cdot 001 + \cdot 003} = 500 \text{ ampères},$$

a current sufficient to fuse, or at least, seriously heat (and

therefore change the resistance of) a resistance coil, even if the latter be very massively constructed, and be only connected to the battery for a very short period of time.

In order to reduce the strength of the current flowing in the circuit either the resistance in the latter must be increased or the electromotive force must be diminished. By the following simple expedient we can effect the required result: Take 11 cells, say, of the battery or accumulator to be tested, and divide them in two sets of 6 cells and 5 cells, and then connect up the two sets in series, but in such a way that the negative pole of one set be connected to the negative pole of the other set, then by this arrangement since the two sets oppose one another, the electromotive force of the whole combination will not be that of 11 cells, but of 6 — 5 or 1 cell, thus we have a battery with a resistance of 11 cells, but with an electromotive force of 1 only. If we make a test with such a battery or accumulator in the manner last indicated, then the shunt which would be used would have a resistance of $11 \times \cdot003 = \cdot033$ ohms, and the current flowing through it would be

$$\frac{2 \text{ volts}}{\cdot011 + \cdot033} = 45\cdot5 \text{ ampères.}$$

It is evident that 45·5 ampères will produce a very much less heating effect than 500 ampères, more especially when we recollect that the heating effect varies as the *square* of the current.

We could, if we pleased, still further reduce the current by employing 10 good cells and 1 partially exhausted one, instead of 11 good cells.

As in any case it is not desirable that the shunt resistance should be exposed to the action of the current longer than is absolutely necessary, the best method of testing to employ would be Munro's.* The contacts (including the key contacts) should be made by mercury cups.

This method of dividing the battery and opposing one half against the other becomes still more practical in proportion as the number of cells to be tested becomes larger, since the greater will be the resistance in the circuit, and the less the current flowing.

If the two opposing halves of the battery be exactly equal, then the latter may be treated as an ordinary resistance and measured by the bridge method.

* See "Handbook of Electrical Testing." New Edition, p. 195.

THE JÜRGENSEN DYNAMO-ELECTRIC MACHINE AND ARC LAMPS.

THOSE of our readers who were fortunate enough to visit the electrical exhibition held in Paris last year will no doubt readily recall to mind the strangely shaped dynamo-electric machine of Profs. Jürgensen and Lorenz, of Copenhagen (better known as the Jürgensen machine), which stood, alone, at one end of the Palais de l'Industrie. The machine excited much curiosity not only on account of its curious structure, but also from the peculiar disposition of the field magnets. The arrangement of the armature and electro-magnet projections brings recollections of the machines of Fein, Heinrichs, and Schuckert. The subjects of the present article have, however, just been experimented with in London, and we therefore purpose giving a full description of Profs. Jürgensen's inventions together with several scientific reports on the efficiency of the machine.

In our abstracts of published specifications columns for January 28th we gave an illustrated notice of this invention, which we reproduce further on, together with a brief extract from *La Lumière Electrique*, published in our "Notes" of February 4th. We have seen the Jürgensen machine and lamps in operation at the Cowper Street Schools of the Finsbury Technical College, and it has been subjected to numerous tests by Profs. Ayrton and Perry, whose reports we are enabled to publish. In principle the machine is precisely similar to the well-known Gramme dynamo-electric machine, from which it differs in construction only. The revolving armature, or induced coil, is wound in exactly the same manner, and the arrangement of the commutator and brushes is likewise that of the Gramme, or very slightly modified. It will not therefore be necessary to say more on these points beyond detailing the way in which the armature is fixed, a way necessarily quite unlike the methods employed in other machines, and which will be found fully explained in the extract alluded to.

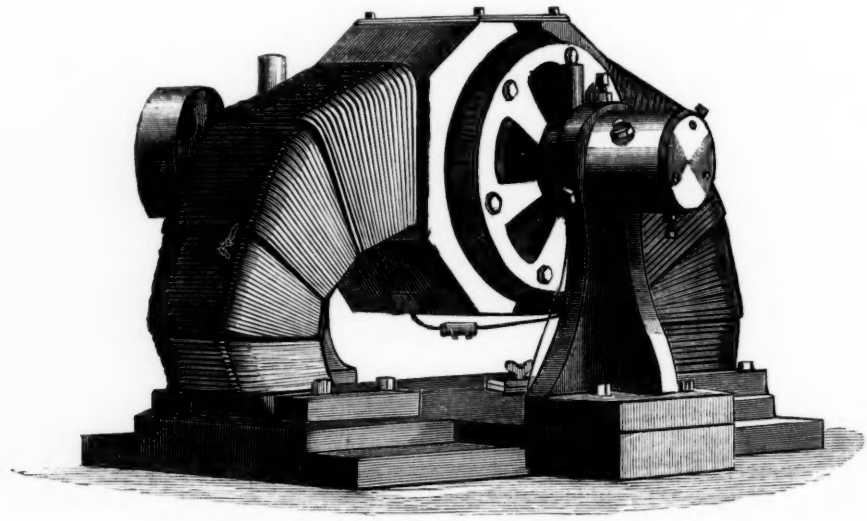


FIG. 1.

Fig. 1 shows a general view of the Jürgensen machine, while fig. 2 presents details of the arrangement of armature and electro-magnets. S, N, are the pole-pieces of the exterior field magnets, and *s*, *n*, those of the interior, E, E, which are fixed; the armature, therefore, runs freely between the poles of the exterior and interior electro-magnets.

Fig. 3 is a portion of the outside field magnet, and shows the method of coiling the wire to secure less heating effect, the convolutions not being closely wound side by side, as is usually the case, but each set of convolutions being slightly separated from its neighbours by the insertion of a little pin between them, as shown at A, A; the wire being represented by the straight lines.

We will now refer to our former description of this machine, which will enable our readers to understand fully the details of construction, both of the armature and the internal electro-magnets. "This magneto-electric machine possesses, generally speaking, more electromotive power than

any of the heretofore known machines acting on similar principles, and the total resistance of conduction in the machine is at the same time very insignificant. The weight

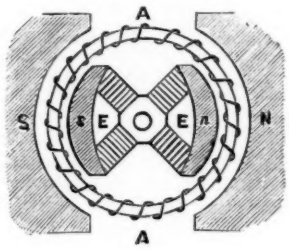


FIG. 2.

and dimensions of the machine are also small, having regard to the power of production. Fig. 4 is an end view; fig. 5 a vertical longitudinal section; and fig. 6 a detail view of a

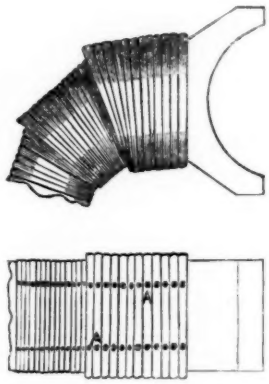
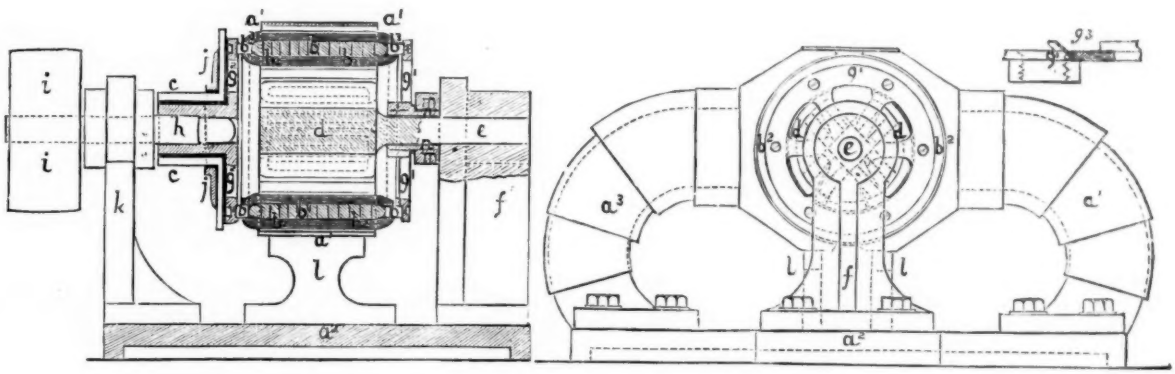


FIG. 3.

magneto-electric machine constructed according to this invention. The machine is on the whole similar to the Gramme machine. It has hence an outer electro-magnet, a^1, a^2, a^3, an annular armature, b^1, having wire coil sections, b^2, and rotating between the poles of the electro-magnet, a contact cylinder, c, at one end, and brushes for collecting the electric current developed. The powerful action of the machine is mainly attained by the application of a central electro-magnet, d, inside the annular armature, b^1, b^2; this electro-magnet is, so to say, formed as two bar magnets placed crosswise, and having the north poles as well as the south poles respectively united by pole-piece; this interior electro-magnet has a central gudgeon, e, which fits in a standard or bracket, f, and is held therein by screws, which, however, are not shown on the drawing, so that the north pole and south pole of the inner electro-magnet are opposite the north pole and south pole of the outer electro-magnet respectively. In order to further steady or secure the armature in its bearing in spite of the interior electro-magnet, there are unmagnetic rings, g^1, g^2, secured by studs projecting from the armature, b^1; of these rings one, g^1, has a central annular steel boss or ring which fits freely round the gudgeon, e, and has a projection, n, which works in the bearing, m^1, and the other ring, g^2, is fast on the spindle, h, whereby the armature is revolved and which consequently has a driving-strap pulley, i. The armature, b^1, is divided into a number of rings arranged side by side, separated from each other by insulating pieces, the whole being held together by bolts placed midway between the aforesaid studs, b^2. By this arrangement induction currents in the armature, b, are prevented in the length direction parallel to the axis; whereby is also attained that very long armatures (that is, in the axial direction) may be used in combination with one or more outer electro-magnets, whereby the power of the machine may be greatly increased. In order to prevent damage to the insulating pieces on the wire coils, b^2, and in the armature, b^1, itself by too great heat produced therein during the working of the machine through the unpreventable resistance to conduction, the spokes which unite the ring, g^1, at the gudgeon end with its boss or nave are chamfered off on the edges, and may also have little wings, g^3, as shown in fig. 6, so that by the revolution of the armature a cooling air current into the armature may be produced in its length direction. The outer electro-magnet of the machine really consists of two electro-magnets, a^1 and a^3, which by the iron bed plate of the machine are united to a single horse-shoe shaped electro-magnet. To prevent hurtful vibration of these two pole-parts, a^1 and a^3, they are steadied against each other at the top by an unmagnetic intermediate piece or plate, screwed thereto, and below by unmagnetic columns, l. In order to obtain the most powerful magnetism with the least conduction resistance, the wire coils are accumulated to the greatest extent near the pole-pieces of the electro-magnet. The electric current to the inner and to the outer electro-magnet may either be taken from the main current of the machine itself, or from a less number of separate wire sections on the armature of the machine, or lastly, from another smaller electro-magnetic machine. The contact cylinder, c, or commutator, consists of angle-shaped copper bars, which by a disc or ring, j, are fastened to the ring, g^2, which is fast on the spindle, h, but of course with insulating pieces between the said bars and the ring, g^2, and its centre boss, and the disc, j. The collecting brushes are not shown on the drawings, as they are of the usual form. They are arranged on the spindle-bearing bracket, k, so that they by being turned round the centre line of the spindle, h, may be set according to the neutral axis of the machine."



FIGS. 4, 5, AND 6.

The special features claimed, we believe, for the Jürgensen machine are: the application in dynamo-electric machines of an electro-magnet within the revolving armature, with or without the use of external electro-magnets; the use of annular armatures made up of a series of sections of narrow rings insulated from each other; the special mode of ventilating and cooling the machine by means of the fan or wings attached to the ring at the end of the armature; and the special form of outer electro-magnet. At the time of the Paris Exhibition we were unable to obtain any data whatever respecting the performance of this machine, although it was claimed that for its size it was the most powerful dynamo-electric machine made. However, soon after the exhibition, some remarks of a critical nature concerning Professor Jürgensen's invention were published in the columns of *La Lumière Electrique*, from the pen of M. Guerout, which read as follows:—

"What constitute the really original part of the Jürgensen machine are—1st, the electro-magnet in the interior of the armature; 2nd, the particular mode of winding the wires of the inductors, and the strong ventilation which the rotation of the armature provokes. This last point, as well as the empty spaces left between the wires of the electro-magnets is advantageous because it lessens the heating of the machine. The concentration of magnetism in consequence of the coil on the polar appendages, is also not without advantages, but the rounded form given to the inductors does not seem to us very logical so far as construction is concerned. From this point of view also, we shall criticise the manner in which the interior inductors are supported, being maintained only by one extremity of their axis. In this position the weight of the electro-magnets must tend to bend the support and to put the machine out of order. Besides, these interior electro-magnets had already been employed by M. Siemens, but with an armature coiled with wire on the outside only, and M. Jürgensen maintains that the presence of the wire in the interior of the ring considerably increases the inductive action in proportion to the action of the interior magnets; we do not, however, think that this is the case. It seems to us that the induction is produced principally by the pole developed in the revolving ring of iron by the inductors, and it matters little whether this pole is caused by the outer electro-magnets alone, or by inductors placed about the interior and exterior. This theory is confirmed by the fact that Fein's machine (see *La Lumière Electrique*, July 13th, 1881), which also possesses interior induction, has not given better results than the Gramme machine. As to the Jürgensen machine, as far as we know, no experiments have been made with it at the Exhibition by which we might judge of its pratical value. The analogy which exists between it and the Fein machine, as regards the manner in which the ring is influenced by the inductors leads us to think that it will give results little different to those obtained from the latter."

M. Guerout had evidently ignored the fact that although interior induction is employed in Fein's machine, the inside pole-piece is merely a prolongation of the exterior, so that the intensity of magnetism in the core of the armature would probably be somewhat weaker than if the exterior only had been used, by reason of the given magnetism in the inductors being spread over a much larger mass of iron. The Jürgensen machine therefore differs from the foregoing, inasmuch as the magnetism in each pole-piece is independent of the other, or in other words, the inside and outside poles are magnetised individually and are not connected together as in Fein's dynamo-electric machine.

We are now in a position to place before our readers such information as will enable them to form their own judgment as to the efficiency of the Jürgensen machine. The first report on its performance is that of Mr. Lund, of Copenhagen, a copy of which we give below. He also alludes to the lamp employed in connection with the machine we are speaking of, and which we also describe and illustrate in the present article.

[COPY.]

The dynamo-electric machine constructed by Professors Jürgensen and Lorenz is remarkable for simplicity in construction, and is therefore very easy to manufacture.

It has the advantage of requiring less driving power relative to the strength of the current obtained, and can therefore be produced at a less cost, and does not become heated.

The coils on the rotating armature are influenced both from the inside and the outside, that is, through their whole length, and thereby there is the advantage that the machine may be constructed proportionately smaller than other machines, and demands less driving power. The inner magnet counteracts the inclination of the outer one to form inductive currents in the armature, as it will itself form such currents in an opposite direction, thus again saving driving power and arresting the production of heat by these currents. Besides which the armature is in heat-conducting connection with the bulk of the machine, for which reason the heat arising in the bobbins cannot ever become very great, as it is continually being absorbed. Further, the coils on the ring are kept cool by a current of air entering at the armature during the rotation of the machine.

The shape of the outer magnets and the way of coiling assist to produce a strong magnetisation as compared with the small amount of coil.

The construction of the machine greatly facilitates any repairs that may be necessary at any time, as both the inner magnet and the rotating armature can be taken out, each separately, without removing the magnets.

The differential lamp constructed by Professor Jürgensen is distinguished for simplicity of construction and quiet and steady light. This is obtained by the way the carbons are kept in the same distance one from the other, which is effected by making the magnetic power of the two solenoids in connection with the carbon-holders always balance one with the other, and no use is made of any mechanism or clockwork whatsoever.

As far as I am aware, the machines and lamps constructed by Professor Jürgensen can be made cheaper than any other, both by reason of their simplicity of construction and easiness of fabrication.

(Signed) L. LUND,

Manager of Works at the Mechanical Establishment of Prof. E. Jüngers, Copenhagen.

Then follow two reports by Professors Ayrton and Perry, which will be found specially interesting.

PRELIMINARY REPORT ON THE JÜRGENSEN DYNAMO-ELECTRIC MACHINE AT MESSRS. JOHNSON AND PHILLIPS' WORKS, CHARLTON.

By Professors W. E. AYRTON and JOHN PERRY, M.E.

LONDON, 1*st August*, 1882.

This machine is what is known as a "series dynamo," that is, the field magnets are in series with the revolving armature.

The two specialities of the machine are—1st, an internal fixed electro-magnet, which together with the external fixed electro-magnet produces the magnetic field in which the armature revolves. 2nd, the special shape given to the external magnets causing them to follow the lines of magnetic force, and therefore theoretically enabling them to produce a stronger magnetic field for the same strength of current and number of convolutions of wire.

Both these specialities in the machine are advantageous in enabling a strong magnetic field to be created, and therefore a high electromotive force.

We made certain tests of the current and electromotive force produced by the machine running at different speeds, 1st, when two arc lamps were in circuit; 2nd, when one arc lamp was in circuit; and lastly, when various resistances were introduced, and the following are the results we obtained:—

No. of revolutions per minute.	Current in ampères.	Electromotive force in volts between the terminals of machine.	Approximate total electromotive force of the machine.	Resistance in the external circuit in ohms.	Remarks.
800	17·3	78·3	126		2 arc lamps burning in circuit
840	18·1	97·2	148		" " "
550	15·4	58·0	101		One " " "
620	14·3	65·3	106	4·5	
610	16·4	54·5	103	3·3	
620	20·7	43·8	102	2·1	
560	24·2	28·1	97	1·2	
630	25·8	29·0	103	1·2	

If the last set of observations be reduced all to the same speed, 620 revolutions per minute, the total electromotive force becomes:—

106 volts.
105 "
102 "
107 "
103 "

From this it is seen that for currents in the field magnets varying from 12 to 26 ampères, the total electromotive force is nearly constant, which shows that for the smaller current the field magnets are already satiated. Hence less wire might advantageously be used on these magnets, producing a resistance less than 1·1 S. U., which, we are informed, was the resistance of the internal and external field magnets together; that of the revolving armature being, we were informed, 1·75 S. U.

The greatest power electrically developed by the dynamo during the preceding experiments was 3·6 horse-power, and the greatest horse-power usefully electrically developed, that is developed in the external circuit, was 2·4.

We were not able to judge of the efficiency of the machine, that is the proportion of the horse-power electrically developed by the dynamo to that given to it by the steam-engine, because there was no transmission dynamometer available, or arrangements for taking indicator diagrams of the engine.

It is most important, in order to judge of the commercial value of the Jürgensen dynamo, that dynamometer tests of the transmitted power should be made simultaneously with those of the electric power given out by the dynamo, or if time does not allow of a transmission dynamometer being obtained and fixed in position, that the cylinder of the engine should be bored for the insertion of an indicator, so that indicator diagrams may be taken simultaneously with the electric tests.

REPORT ON THE JÜRGENSEN DYNAMO MACHINE AND LAMP.

68, SLOANE STREET, S.W.

September 4th, 1882.

WE have made a large number of experiments with this machine at different speeds, and sending currents through various resistances. In each case there were measured—

1. The horse-power actually given to the dynamo.
2. The speed of rotations of the dynamo.
3. The current in ampères generated.
4. The electromotive force in volts set up between the terminals of the machine.

We find that for currents of over 15 ampères at the lower speeds of 500 to 600 revolutions per minute, and for currents of over 12 ampéres at the higher speeds of 750 to 950 revolutions, the efficiency of the machine was half, or more; that is to say, for every horse-power given by the engine to the dynamo at least one-half a horse-power was electrically given out by it, part of this being given out in the external circuit, and part appearing as heat in the armature and field magnets of the machine itself.

At a speed of 790 revolutions per minute, when the external resistance was equal to 3·9 ohms, the efficiency of the machine reached 0·93 and the useful efficiency to 0·54, that is to say, of the horse-power given by the engine to the dynamo 93 per cent. was given out electrically by the dynamo, 54 per cent. appearing in the external circuit.

In this case the actual horse-power given to the dynamo was 4·9, of which 4·6 was reproduced electrically by the machine, 2·6 of this appearing in the external circuit.

At a speed of 930, with 8·7 ohms in the external circuit, the total efficiency of the machine was 0·77, and the useful or commercial efficiency to 0·58, or nearly six-tenths of the total power given to the dynamo was reproduced electrically in a useful manner in the external circuit.

In this latter case, a current of 14 ampères was sent through the external resistance of 8·9 ohms. Now, when two of Mr. Jürgensen's lamps were in circuit we found the external resistance to be about 7 ohms and a current of about 14 ampères to give the best results after the lamps had been adjusted by the gentlemen who represented the inventor.

Hence under the ordinary conditions of burning the Jürgensen machine may be expected to have a total efficiency of about 0·8, and a useful or commercial efficiency of about 0·6 may be expected in the external circuit.

A sample of some of the results obtained follows:—

Rates of power appearing usefully in external circuit to power given to dynamo.....	0·44	0·54	0·58	0·58
Rates of power given out by dynamo to power given to dynamo	0·85	0·93	0·84	0·77
Horse-power appearing in the external circuit	2·4	2·6	2·6	2·4
Horse-power given out by dynamo	4·5	4·6	3·7	3·1
Horse-power given to dynamo by engine	5·3	4·9	4·5	4·1
Total electromotive force produced by dynamo in volts..	141·6	150	160	165
Electromotive force produced in the external circuit, in volts.....	73·8	88·2	109·8	124
Current in ampères	23·8	22·4	17·5	14·3
Resistance in the external circuit in ohms	3·6	3·9	6·2	8·7
Speed of dynamo, number of rotations per minute.....	744	790	848	930

In order to determine the efficiency of the lamp, that is, the number of standard candles illuminating power per horse-power electrically given to the lamp, the current passing through it was measured in ampères, the electromotive force between the terminals in volts, and simultaneously the illuminating power.

The beam of light coming at different angles in succession from the lamp was received in the photometer, and several measurements were made at each angle. Negative angles mean that the lamp was below the photometer, and therefore sending rays up, while the positive sign before the angle indicates that the lamp was above the photometer and therefore sending the rays down.

The light was examined through red glass as well as through green glass, in order to compare its intensity with the red light of a standard candle and with the green light.

The more important of the results of the measurements are contained in the following table.

Current in amperes.	Electromotive force in volts between the terminals of one lamp.	Horse-power electrically given to lamp.	Angle of elevation.	Intensity of light in standard candles.		Standard candles per horse-power.	
				Red.	Green.	Red.	Green.
16·5 to 17·9	44·3 to 48·6	1·04 to 1·14	−32°	205 to 223	436 to 491	197	414 to 462
15·8 to 16·8	48·6 to 49·7	1·03 to 1·12	−10°	179	321 to 365	174	295 to 326
16·1 to 17·2	47·2 to 54·4	1·06 to 1·17	0	488 to 558	526 to 579	425 to 500	496 to 677
14·7 to 16·1	47·5 to 51·1	·98 to 1·05	+ 7°	322 to 348	724 to 788	316 to 332	738 to 783
17·15	45	1·035	22½°	620	1863	602	1795
17·5 to 18·2	48·6 to 51·1	1·25 to 1·24	34°	1127	2242 to 2415	951	1937
14· to 14·7	41· to 42·5	·797 to ·808	40°	503	1179	622	1480
14·7 to 16·1	46·8 to 51·5	97 to 1·03	,,	841 to 916	2471 to 2518	871 to 916	2434

The lamp burnt steadily, and with proper resistances given to the three solenoids the feed of the carbons could be made extremely regular, and the light therefore very constant.

(Signed) W. E. AYRTON.
JOHN PERRY.

We made a few observations last week in an article concerning the faulty designing of dynamo-electric machines which often occurs, and a case in point crops up in the first report of Messrs. Ayrton and Perry. The electro-magnets in the Jürgensen machine might, it will be seen, have been as powerful with considerably less wire coiled upon them

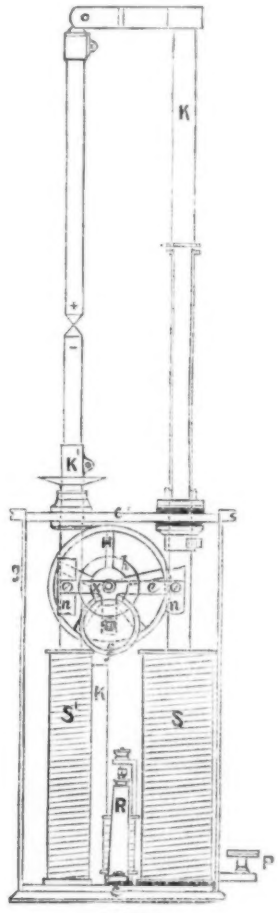


FIG. 1.

and it was this particular example that we hinted at to the effect that it would probably be shortly brought before the notice of our readers.

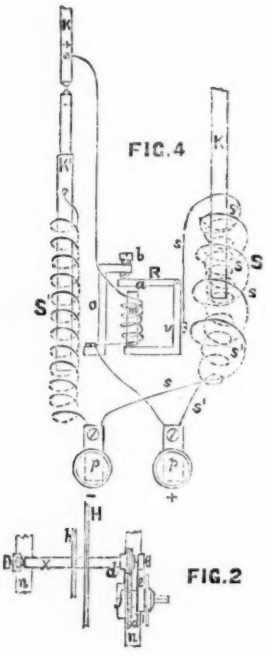
It follows, then, that the machine can be made equally effective at a smaller cost than as now constructed. Professor Jürgensen's lamp of the arc type and of fixed focus is illustrated in the drawings herein annexed, both in detail and in full.

Fig. 1 is a side elevation, figs. 2 and 3, elevations of details, and fig. 4 a diagrammatic view of the arrangement.

The two carbon-holders, K′, K, are respectively supported by two grooved circular discs or pulleys, *h* and H, fixed on a common axis carried by the frame work. When either carbon is raised, the axis, *x*, and discs are turned, whereby the other carbon-holder is lowered, and *vice versa*.

The carbon-holders are guided by suitable bushes in the plate, C^1, forming the cover of the case, *g*, and by the solenoids, S^1 and S, into which they are extended by means of rods of soft iron. The radii of the above-mentioned discs, H and *h*, are made proportionate to the lengths of carbon that are burnt away during the same period of time, from the upper and lower carbon points respectively, so that the arc is always maintained in the same place in the lamp.

The two solenoids, S^1 and S, are connected together by the binding screws, P and P^1, a contact apparatus, R, and the carbon-holders, K^1 and K, as shown in fig. 4.



Before the lamp is connected with the wires, a movable armature, A, in the contact apparatus, R (figs. 3 and 4), will always be held in contact with an adjusting screw, B, in an insulated carriage, O, by a spiral spring attached to the carriage, Y.

Supposing the carbon points to be so far removed from one another at the moment when the electric current is admitted to the apparatus, that no luminous arc can be formed between them, a part of the current will pass from a binding screw, P^+, through the insulated carriage, O, the adjusting screw, B, the movable armature, A, the insulated carriage, V, the outer coils of the wire, S, in the solenoid, S, to another binding screw, P^-.

The upper carbon-holder, K, is thereby drawn downwards into the said solenoid, S, and the lower carbon-holder, K^1, is raised by the action of the discs, H, *h*, as above explained until a luminous arc is formed by a branch of the current which then passes through the first-mentioned insulated carriage, O, the solenoid of an electro-magnet, *m*, to the upper carbon, and thence through the arc, the lower carbon and the solenoid, S^1, surrounding that carbon to the binding screw, P^-.

As soon as the current has thus branched off the armature, *a*, is attracted by the before-mentioned electro-magnet, *m*, and the current from the insulated carriage, V, of the said armature to the outer coil, S, of the upper carbon solenoid, S, is broken.

The upper carbon solenoid, S, now only receives a branch of the current which, from the moment the current enters the lamp, passes from the binding screw, P^-, up through the outer coil, S, of the upper carbon solenoid, then through another finer coil, S^1, within the first-named, back to the binding screw, P^+.

The magnetic attraction of the upper carbon-holder, K, effected by this branching of the current, counteracts the attraction of the lower carbon-holder, K^1, by the lower carbon solenoid, S^1, and the current in the upper carbon solenoid, S, becomes proportionally stronger, consequently the carbon points approach one another till the normal condition of the currents in the solenoids is re-established.

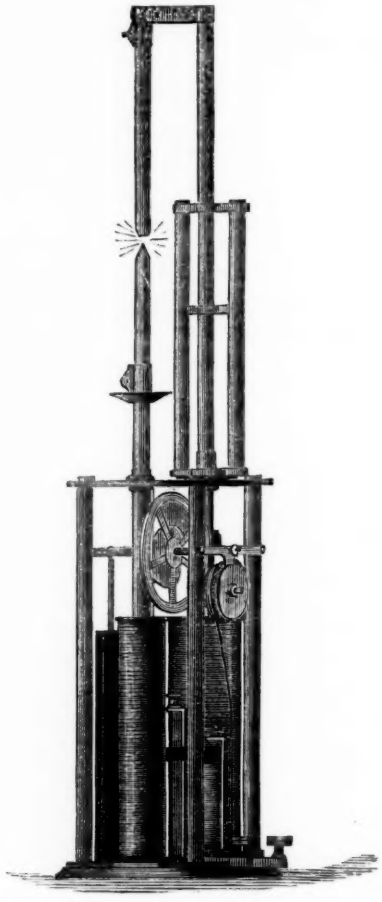


FIG. 5.

GENERAL VIEW OF LAMP.

When the luminous arc becomes shortened from any cause the current in the lower carbon solenoid, S^1, becomes stronger, while that in the upper carbon solenoid, S, becomes weaker, and the carbon points will be separated further apart.

In order to regulate or reduce the movements of the carbon-holders so that no objectionable unsteadiness of the light shall occur, one of the carbon points is connected with the piston rod of a hydraulic brake, K. To enable the lamp to be used with currents of different tension, the axis, X, of the discs is connected by a toothed pinion, *d*, and wheel, *d*, with an enclosed spring, F. By regulating the tension of this spring as required, the said axis, X, can be balanced to suit any particular case.

The lamp may be arranged so as to hang down, but in

that case the mechanism must be so adapted that the carbon points are placed below.

The claim in this lamp is for the use of two solenoids, S and S^1, each working direct on their respective carbon-holders, K and K^1.

The English patents for the machine and lamp are dated as follows:—No. 2416, 1881, dated June 1st, and granted to Frederick Wolff, and No. 3385, dated July 17th, 1882, granted to L. A. Groth.

In our concluding remarks we may add, that the machine we have described, constructed to produce 21 lights of 2,000 candle-power each, is comparatively small, its base being 28½ inches in length, and 21½ inches in width, across its middle, (the widest part). The armature is about 10½ inches in diameter, and the length from end to end of the supporting rings, 9 inches.

The peculiar fixing of the armature and the internal electro-magnet may be thought a weak point, but we understand that a well-known mechanical engineer whose name we are not at liberty to give, considers it perfectly safe, and his opinion in such matters is certainly a sufficient guarantee. The cost of this machine in Copenhagen is about £33, so it appears that a considerable demand for such a powerful dynamo-electric machine will probably result, as its selling price should be much less than others in the market. A large machine for the Danish Government, producing a light of 25,000 candle-power, cost in Copenhagen only £55 to manufacture.

We consider this machine an excellent one, and its efficiency stands very high indeed. The lamps do not strike us so favourably, being somewhat clumsy, but their regulating action is very good, and with a better mechanical design there would be little fault to be found. Indeed, we have learnt since our inspection of Prof. Jürgensen's inventions, that these lamps are not intended to exemplify the best form that can be obtained, and that others of a superior character are being manufactured abroad. In regard to the patents, we are informed that the opinions of competent judges, is to the effect that the Jürgensen system does not infringe others.

The following is a list of some of the places where the Jürgensen system of electric lighting has been adopted and fitted up.

By the royal Danish Government for the use of the royal engineers and the royal artillery corps; the spirit works at Roskilde; the brewery "Albani Odense;" the brewery "Gl. Carlsberg," Copenhagen; the brewery "Ny. Carlsberg," Copenhagen; sugar works, Nakskow, Copenhagen; "Detforende Dampskibselskal" Steam Ship Company, Copenhagen; the Danish spirit works, Copenhagen.

Besides the above, concessions have been granted to Mr. Groth, the representative of the system in England, to fit up the system at the Royal Palace at Stockholm; most of the principal streets in Stockholm; the town of Malmo, Sweden; the town of Wexio, Sweden; the town of Christianstad, Sweden; the Café Bauer in Berlin; Fridrich Strasse in Berlin, &c., &c.

THE BRITISH ASSOCIATION.

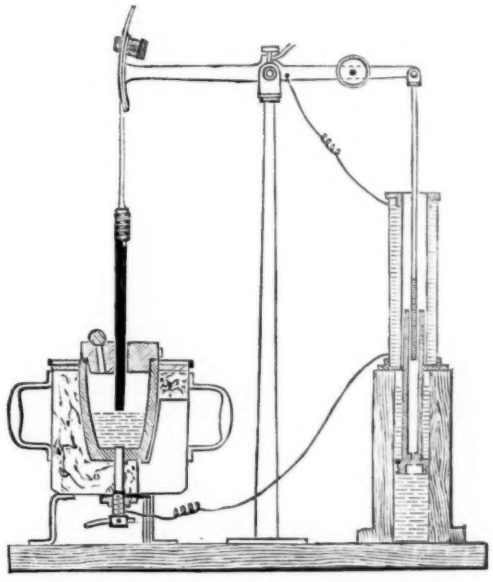
ON THE ELECTRIC FURNACE.

By C. W. SIEMENS, D.C.L., F.R.S., and A. K. HUNTINGTON, Professor of Metallurgy, King's College, London.

[Read before Section B of the British Association at Southampton.]

THE electric furnace has previously been described in the *Journal of the Society of Telegraph Engineers*, June, 1880. It has since been found advisable to surround the furnace with a coil. By this means the direction of the arc can be regulated at will, and the tendency which it has to fly to the sides of the crucible be checked.

The furnace consists of a crucible of any convenient size, in the bottom of which is pierced a hole to receive the positive electrode, the negative electrode, which passes through a hole in the lid of the crucible, being suspended from one end of a beam, the other end of which is attached to a hollow cylinder of soft iron, free to move vertically within a solenoid coil of wire. The force with which the cylinder is drawn into the coil can be counterpoised by a sliding weight on the beam. One end of the solenoid coil is connected with the positive, and the other with the negative pole. The coil having a high resistance, its attractive force on the cylinder is proportional to the electromotive force between the electrodes, *i.e.*, to the resistance of the arc. The length of the arc is, therefore, regulated automatically. This is a point of great importance, as, were it not so, the resistance of the arc would rapidly diminish as the temperature of the atmosphere within the crucible increased, and the result would be that heat would be developed in the dynamo machine. The extinction of the arc by sudden change in its resistance or by the sinking of the material in the crucible is thus also avoided. The crucible is surrounded with some infusible substance, which is also a bad conductor of heat. Gas retort carbon or sand answers well for the purpose. The electrodes may be of such carbon as is used in electric lighting or of any other convenient conducting substance. They may, if desired, be cooled by circulating water through or round them, or by exposing them as far as possible to the air. For example, in one experiment a ½-in. nickel positive pole was employed, the lower end being inserted into a solid rod of copper about 1 in. square by 6 in. long. With this pole, no other means of keeping it cool being adopted, 1 lb. of grain nickel was fused in a clay crucible and poured in eight minutes, starting with all cold. The electrode was but little attacked, and no leakage occurred.



There are two great advantages possessed by the electric furnace, viz., that the temperature attainable is practically only limited by the refractoriness of the materials of which the furnace is constructed, and that the heat is developed immediately in the material to be fused, instead of first having to pass through the containing vessel. The temperature to be obtained by the use of fuel is limited by dissociation. Deville has shown that carbonic acid undergoes dissociation at the ordinary atmospheric pressure at about 2,600 deg. Cent.—4,700 deg. Fah.

In the experiments made by the authors, five D 2 machines driven by a Marshall's 12 horse-power engine were employed, one being used as an exciter. The current ranged between 250 and 300 ampères. The most refractory clay crucibles supplied by the Patent Plumbago Crucible Company were invariably cut through in a few minutes, and, except for experiments of short duration, were useless. Plumbago crucibles stood exceedingly well. Obviously, however, they could not be employed for all purposes, owing to their tendency to cause carburisation of the metal experimented with. In some experiments the fusion of metal was effected in a bed of lime, sand, or electric light carbon dust. The latter is a very bad conductor, and, as in the case of lime and sand, allows the arc when once formed to maintain a passage through it to the metal beneath.

Wrought Iron.—Six pounds of wrought iron were kept under the action of the arc for twenty minutes, and the metal then poured into a mould. It was found to be crystalline, and could not be forged. This is the result which has always been obtained when iron, nickel, or cobalt have been fused. Although the remedy, viz., the addition of a little manganese just before pouring, is well known, the cause remains still unexplained.

Steel.—As much as 20 lb. of steel files have been melted in one charge, the time required being about one hour, starting with the furnace hot. With such large quantities the metal has invariably been full of blowholes.

White iron, fused in a clay crucible for thirty minutes, when fractured did not appear to have undergone any change. White iron and coke were introduced into the furnace; the resultant metal was slightly greyer than the original. When, however, retort carbon was substituted for the coke a good grey iron, soft and easily workable, was readily obtained in fifteen minutes, starting with the crucible hot. On another occasion, starting all cold, at the end of thirty minutes the metal, although it had been well fused, had not been rendered greyer. The difference between these two results was possibly due to the temperature being somewhat higher in the one case than in the other. This is a point of considerable practical interest. Four pounds of white iron, fused with carbon dust for three-quarters of an hour, yielded a very grey crystalline iron. In

another experiment, in which 8 oz. of grey iron, produced in the electric furnace from white iron, were remelted in carbon dust for ten minutes a very grey metal was obtained, from which on slow cooling a large quantity of graphite separated.

Cast iron, fused and kept under the action of the arc for forty-five minutes in carbon dust, was not materially changed as to greyness, and the general character of the metal as to the way in which it worked under the tool was not materially altered. The object of the experiment was to ascertain the maximum amount of carbon iron is capable of taking up under circumstances presumably the most favourable. The result is hardly that which would have been anticipated. Some of the same cast iron was fused for fifteen minutes under lime, which nearly covered it. The character of the fracture of the metal was but little altered by this treatment, when slight differences, due to the rate of cooling, are taken into account. A strong smell of phosphoretted hydrogen or of a phosphide was perceived—probably the latter. This was only observed in the experiment in which lime was used. The lime employed still retains a very offensive odour.

When *spiegeleisen* was fused in a plumbago or a clay crucible graphite separated as the metal cooled.

Siliceous pig iron, containing about 10 per cent. silicon, was fused by itself; it showed but little change, except that some graphite was separated. A similar result was obtained when 5 lb. of the siliceous pig were fused for one hour in carbon dust. On fracturing the ingot obtained, a large quantity of scales of graphite was found in a hollow which traversed nearly the whole length of the ingot at its centre. The fracture of the metal was still that so characteristic of highly siliceous iron, and was practically the same as that of the original pig iron.

A series of experiments was made to determine the maximum amount of carbon pig iron is capable of taking up in the presence of a given quantity of silicon. Grey cast iron and pig iron containing 10 per cent. of silicon were fused together in carbon dust, the ratio between them being varied so as to yield metal with from ¼ per cent. to 9 per cent. of silicon.

A similar series was made, only substituting sulphur for silicon. No odour of sulphurous acid was perceived; therefore, presumably, no sulphur was volatilised. This is somewhat remarkable, considering the nature of the experiment. It was thought that investigations of this kind might have an important practical as well as more purely scientific interest—admitting, for the sake of argument, that any such distinction really exists—in assisting to determine the conditions in the blast furnace, &c.

Nickel.—A positive pole of this metal—cast malleable by Wiggin and Co.'s process*—½ in. in diameter, was passed through a hole in the bottom of a clay crucible. A carbon negative pole was used, but soon after the commencement of the experiment a deposit of nickel formed on the end of it, so that practically it was a nickel pole. This deposition of metal on the negative pole was also observed with some other metals—notably with tungsten. Whilst disclaiming any special knowledge on the point, Professor Huntington suggested whether this phenomenon—which is the reverse of that generally recognised as taking place—might not depend on the relative volatility of the matter composing the poles. In the furnace arranged as just described, 1 lb. of grain nickel was fused and poured in eight minutes. The fused metal had a brilliant granular fracture. It could not be cut properly in the shaping machine, shearing off under the tool. One pound of grain nickel, fused in carbon dust for twenty-five minutes, yielded a dark gray carburised metal, which worked well under the tool. On another occasion an equal quantity of nickel, similarly treated, gave a "blowy" metal, which could not be worked. Some carburised nickel, made as described above, was fused in a clay crucible for twelve minutes, and allowed to cool gradually in the furnace; the fracture became whiter, and the grain closer.

Copper.—Three quarters of a pound of copper were fused for about half an hour in carbon dust. On examining the result, it was found that all but about ¾ oz. had been vapourised. Those who were present during the experiments suffered no ill effects from the atmosphere charged with copper which they must have breathed.

Platinum.—Eight pounds of platinum were rendered perfectly liquid in about a quarter of an hour.

Tungsten.—Half a pound of tungsten in powder was subjected to the action of the arc in a clay crucible. Dense fumes were evolved, a cavity about 1½ inches across the top being formed. The furnace was allowed to cool down slowly. When the crucible was removed it was found to have been very much attacked below the point to which the arc extended. The inference is that the crucible had been attacked by the metal at the temperature of the experiment. The metal was fused only to an inappreciable depth beneath the cavity formed by the arc. The unfused metal underneath was covered with very beautiful iridescent crystals of tungsten, which under the microscope appeared to be well-formed prisms. They have not yet been measured. The crystals had evidently been formed by the slow cooling of the vapour distilled down from the surface.

A very large number of experiments was made with tungsten, the results of which showed that it could not be fused, except in very small quantities at a time. It was possible to build up a small ingot by fusing a little of the tungsten, and then adding little by little gradually. Even then the pieces obtained were for the most part spongy and unsatisfactory. The best results arrived at were when tungsten which had already been fused was employed in the building-up process. Once the metal had been fused it did not fume much in melting, doubtless owing to the greatly reduced surface exposed.

Tungsten fused in the electric furnace is, when untarnished, pure white, and brittle, the grain being very close. Tungsten hitherto has only been obtained, as a gray powder, by reducing the oxide with carbon or hydrogen, or in minute globules, in the ordinary small electric arc. Tungsten has its fusing point lowered by the addition to it of carbon. Under these conditions a solid piece of moderate size can, without much difficulty, be obtained. From 1000 grains of powder fused in carbon dust 650 grains were recovered, the remainder having been volatilised, and from 450 grains of the fused metal 410 grains were obtained on refusion. One piece of tungsten which had been treated under the conditions most likely to cause it to be highly carburised was analysed. It contained 1·8 per cent. of carbon. The metal was very white, close in grain, and brittle.

From the foregoing experiments it is clear that the amount of any given metal which can be successfully fused in the electric furnace, and the time required in effecting the fusion, are dependant on (*a*) the relation between the volatilising point and the fusing point, *i. e.*, the extent to which the volatilising point is higher than the fusing point; (*b*) the conductivity of the metal for heat.

It thus happens that platinum can be more readily melted than steel, and in greater quantity for a given expenditure of energy. This inference is believed by Professor Huntington to be justified by the observations and experiments so far made.

It still remains to examine chemically the specimens referred to in this paper.

In the discussion on the communication made by Professor Huntington, Dr. Siemens remarked that the limit of the temperature producible by means of the electric furnace is as yet unknown, for although the heat would probably increase the resistance of the arc, that in itself would only cause a further development of heat. The results obtained with copper, although apparently pointing to a drawback in the use of the furnace for melting purposes, yet might prove of importance in dealing with metals in the vaporous condition. He could not agree with Professor Huntington's suggestion as to the cause of the deposition of metal on the negative pole. He thought it was due to the negative pole being much cooler than the positive.

Dr. Gladstone inquired whether the deposit was crystalline or in fused globules.

Prof. Huntington replied that it was in the latter condition.

Mr. Terrill (Swansea) remarked that the loss of copper by volatilisation in smelting was much greater than it was generally supposed. During an accidental escape of sulphuretted hydrogen in the works he had observed a thick deposit of sulphide of copper extending over a large area. He had detected copper deposited even on the zinc counter of the refreshment bar at the railway station some distance from the works. The discussion was continued by Mr. Maxwell Lyte, Prof. Vernon Harcourt, and the president, Prof. Liveing, who thought that such experiments as had been made might be of great service in the study of metals.

* See paper on "Nickel and Cobalt" by H. K. Huntington, in July number of the *Journal of the Society of Chemical Industry*.

ELECTRO-MOTORS.

We illustrate below two electro-motors, one of which (fig. 1) will be readily recognised as that of the well-known Griscom apparatus. The subject of electrical transmission of power we have touched upon in our other columns.

It is well known that a dynamo machine is reversible, that is, if a current be sent through its coils, the armature will revolve at a greater or lesser speed, according to the current strength. This fact led inventors to turn their attention to some simple means of converting the current from galvanic batteries into power; and many attempts were made, more or less successfully, to get a small but powerful engine driven economically by battery power. This matter has long been worked at by an American inventor, Mr. William W. Griscom, of Philadelphia, who has given much time and money to the perfection and manufacture of an electro-motor, which is styled, for reasons enumerated below, the "double induction motor." The construction and action of Mr. Griscom's motor is thus described:—

"The machine consists simply of a small Siemens' armature, revolving in a fixed ring of malleable cast iron, about 2¼ in. long and 2 in. in diameter. On opposite sides of this ring, poles are formed, as shown in the accompanying view, about 1 in. wide, and extended at each end to afford a means of attaching the end plates of the machine, which carry the bearings, binding screws, &c. With the exception of the poles the ring is covered with two coils of coarse wire, both coils being connected with each other, and also with the battery that ordinarily serves as the source of power. The battery current is also led to the revolving armature by means of two pairs of small rollers mounted at the ends of light springs attached to one of the circular end plates, the direction of the current being reversed at each revolution of the armature. The pole-pieces of the latter are curved so as to be concentric with the enclosing ring, and of such dimentions that they are in very close proximity to the inner surface of the coils around the ring.

"As the revolving armature constitutes an electro-magnet, induced currents are developed, which on account of the arrangement of the commutator are always of the same

nature for one half of the ring, and of the opposite nature for the other side of the ring, that is to say, each pole of the revolving armature is alternately north and south, during each revolution, being changed by the action of the commutator, as the armature passes the opposite poles of the enclosing ring. The coils around the fixed ring are wound in opposite directions, so that the currents induced by the

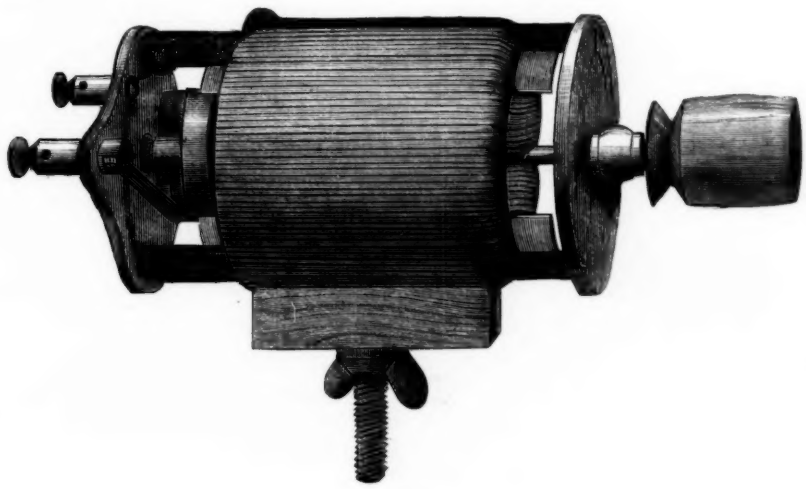


FIG. 1.

opposite poles of the armature at the same time, are of the same nature, and instead of neutralising each other contribute to the efficiency and power of the motor, while their direction is always the same as that from the battery which electro-magnetises the fixed armature. From this description it will be seen that the principle of the machine is to

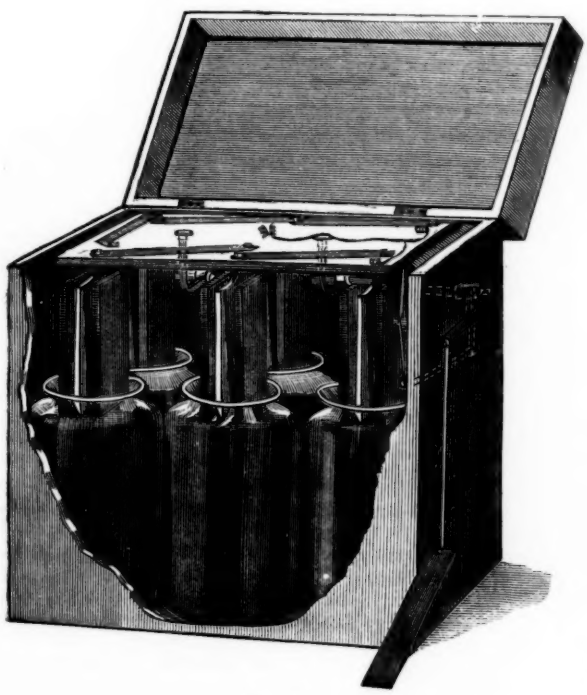


FIG. 2.

utilise the induction currents from the revolving armature, and to add them as supplementary and useful currents to that passing from the battery to the coil on the ring." It is further stated that "this utilisation of the induced current, which in other motors has been a fatal disadvantage, is a feature which greatly increases the facility of working, and enables, with very light weight and in small space, to have a really very powerful engine." The smallest motors made by the manufacturers of the Griscom motor are only 2½ lbs. weight, but are said to be capable, with a suitable current, of doing work equivalent to 1 man-power.

The motor may be driven by a battery, or several motors may be driven by a dynamo-electric machine, or by accumulators. One bichromate battery of six cells is sufficient to drive such a motor as we have described at a speed of 5,000 revolutions a minute, the power developed being sufficient to work a small lathe or a sewing machine at a very rapid rate. The intensity of the current, and therefore the speed of the motor, can be regulated by immersing the couples of the battery more or less deeply in the solution, which is done by means of a pedal placed conveniently to the foot of the operator. It is stated that a single charge of the battery is

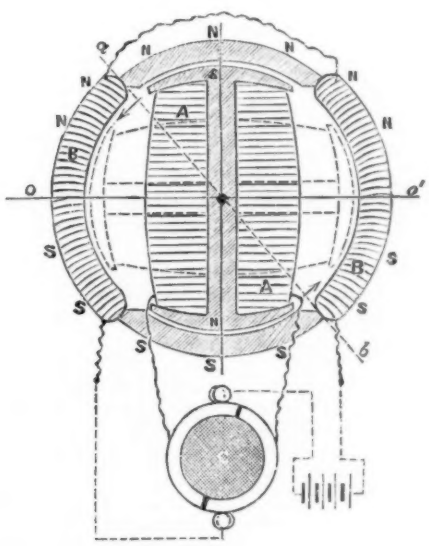


FIG. 3.

sufficient to produce 1,000 yards of average stitches in a sewing machine.

These motors may be made of any size, the power of course rising in proportion. There is no limit to the applications of electro-motors, which range from sewing machines to tram-cars, and from rotary fans to rock-drilling. A factory fitted up with a steam-engine and dynamo can, without any shafting, have a separate and independent motor driving each tool, its power being proportioned to the tool. The cost is said to be very trifling, being estimated at one penny per hour per horse-power. The simplicity of the

motors makes them very cheap to manufacture, and amongst their merits that of extreme cheapness must not be omitted. When used independently for sewing-machines, dental lathes, &c., the battery used (fig. 2) is an improvement on the ordinary bichromate battery. This is so arranged that the plates are lifted clear of the liquid by a spring, and allowed to drain. This avoids the usual expense of having the battery re-charged frequently. By this means the battery not wasting when not at work, it will last for a considerable time with a single charge. The speed and power can be also regulated by dipping the plates more or less in the liquid. This battery is enclosed in a tight box, which may be used as a seat by the operator.

By referring to the diagrammatic sketch of this apparatus (fig. 3) we think that we can make it evident that Mr. Griscom is mistaken in his idea that the induced current assists him in any way. As the connections stand the magnetism of the armature, A, is changed every half revolution. The change does not take place until the centre line of the armature has arrived at *a*, *b*; as the commutator, C, has the position shown in the diagram when the armature poles are *directly opposite* the poles of the ring, B. We will assume that the change has occurred, and that the armature is in the position of the dotted line, *a*, *b*, travelling in the direction of the arrows. Each half of the ring is magnetised oppositely, as shown by the letters N, N, N; S, S, S; and the neutral point is at O, O'. It is very well known that if a battery and galvanometer be connected in circuit with an electro-magnet, then if by any means the magnetism is suddenly weakened the current then set up is found to be in the same direction as the battery current, as indicated by a momentary increased deflection of the needle. If, on the other hand, any increase in the magnetism be rapidly effected, the extra current is then opposed to the main current of the battery.

If the Griscom motor is considered from this point of view the inventor has not apparently overcome the difficulty common to other motors, as he believes. When the S pole of the armature is *approaching* the N of the ring, the magnetism is increasing; and when it is just *leaving* the same pole, it is suddenly changed to N; and is then approaching the S pole of the ring, the magnetism again increasing. Of course the same remarks apply to both poles of the armature. It must be clear, therefore, that the induced current is in an opposite direction to the current of the battery.

Indeed, it is hardly credible that Mr. Griscom could expect to get more current than is produced direct from his battery, or stated in another way, that his motor should give out *proportionately* more energy than is communicated to it, which is the equivalent of Mr. Griscom's reasoning. However, these facts do not detract from the simplicity and usefulness of the apparatus he has devised.

The double roller contacts in the motor we have described are certainly advantageous in reducing friction and wear, and as one is in advance of the other, the sparking at the commutator is reduced to a minimum. We should, however, be inclined to think that they are used at the expense of a good connection, and the probability therefore is that the available current would be somewhat reduced.

The second electro-motor shown, fig. 4, has been designed by Mr. Chaster, whose telephone we illustrated and described last month. The illustration itself is an almost sufficient explanation. The apparatus has six terminals, and the connections may be so arranged as to make it act as a generator with the field-magnets forming a shunt circuit; or as a motor, when armature, electro-magnets, and battery, are all in one circuit, as shown in the "Griscom" diagram. It is exceedingly well made, is free of patents, and we believe Mr. Chaster has supplied either directly or indirectly a considerable number of the motors. The field-magnets are of a different form to those adopted in the "Griscom" system, and slit-springs are employed for commutator rubbers, instead of rollers. We have no actual information concerning the efficiency of Mr. Chaster's motor, but we understand that the smallest size has been usefully employed to operate the overhead motion of a small lathe.

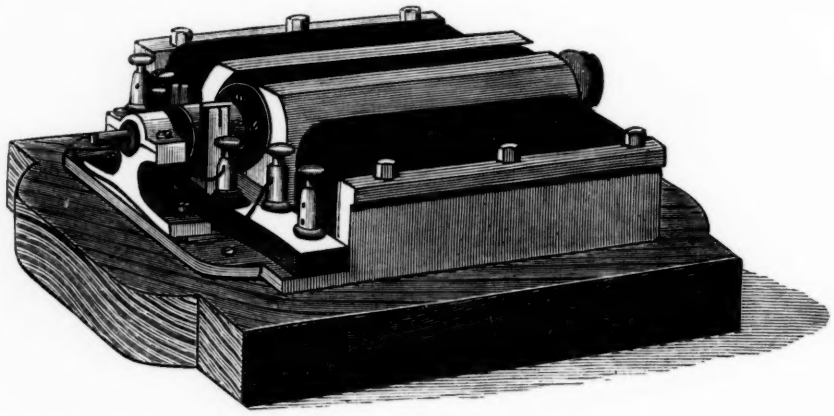


FIG. 4.

CORRESPONDENCE.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Correspondence should arrive not later than Tuesday morning if it is desired to appear in the following number.

MANGANESE.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—In reference to the letter of "An Old Subscriber" in your issue of the 9th inst., page 205, I have had upwards of a quarter of a century's experience in manganese as a speciality and can give your correspondent every required information, which I shall have pleasure in doing, if you will put him in direct communication with me; for to go thoroughly into details would probably occupy more space than your valuable Journal can afford.

In the meantime, if "An Old Subscriber" will give me a sampling and inspecting order for the 50 tons trial shipment to London alluded to, I will be able to advise him reliably *re* the value and disposal of this and further shipments of the mineral.

I am, dear Sirs, yours faithfully,

GEO. G. BLACKWELL,

Manganese Merchant and Mineral Broker.

Liverpool, *September 15th*, 1882.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—"An Old Subscriber" requires some information respecting manganese, and I tender a few notes on the subject.

With a view of securing the best results from manganese in Leclanché batteries, I obtained various samples and tried them made up, and submitted them to working tests.

Those containing oxide of iron are useless, they cover the cells with the oxide and have a detrimental effect on the zincs. The dead black kind gives very poor results; some kinds which are well crystallised, of a rather bluish tint, give good results at first but are not permanent, I believe owing to its hardness. The kind I find best is crystallised, not very hard, nearly black. When rubbed between finger and thumb it leaves a bluish shining mark like black lead.

W. GROVES.

89, Bolsover Street, London, W.
September 14th, 1882.

THE GÜLCHER ELECTRIC LIGHT.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—We observe that you have in your issue of to-day a notice of the electric lights at the North East Coast Exhibition at Tynemouth. And we regret to observe that although we have had accounts from our agent in Sunderland to the effect stated in the extracts herewith sent you, that you should not have noticed the installation at all.

Yours truly,

ALFRED THOMPSON.
General Agent for the Gülcher System.

121, Bishopsgate Street Within,
London, E.C., *September 16th*, 1882.

[We refer our correspondent to our "Notes" columns.—EDS. ELEC. REV.]

ELECTRICAL INVENTION.

[We have received a letter from a friend from which we publish the following extract, which will doubtless prove interesting to all our readers.]

"You lately inserted a paragraph about the resistance of carbon. The observation that carbon becomes a better conductor when heated is a very old one, and is originally due neither to Mr. S. A. Varley nor to Mr. Shelford Bidwell. Prof. Matthiessen in 1858 (*Pogg. Ann.*, Vol. CIII., p. 432), pointed out the fact as regards graphite and wood charcoal. Beetz in 1860 (*Pogg. Ann.*, Vol. CXI., p. 619), discussed the phenomenon of carbon and some other substances becoming better conductors when heated, and gave an instance also in which a peculiarly fine grained (Paris) gas coke behaved exactly like a metal, whilst other samples of coke less fine grained behaved the other way. At that date the phenomenon was no novelty. What a pity it is that people cannot be saved the trouble of re-inventing and rediscovering old things.

"With regard to Mr. Lowdon's letters to you, that which appeared in your previous No. is quite correct. I remember reading an account of the experiment of telegraphing without wires, by means of immersed plates in a river, twenty years ago. I think you will find that it is the subject of at least one patent. This world must be coming to an end shortly, we seem to have tumbled upon a sort of universal resurrection of dead and gone electrical facts."

IMPROVEMENTS IN ACCUMULATORS.

WE have no intention of prolonging the discussion with M. Blanchart; indeed, it has already lasted too long. We criticised his method of calculation, and our opinion remains unaltered, notwithstanding the long reply of our esteemed correspondent. The figures 23,600 kilogrammetres per kilogramme of active material is at once surprising and fanciful, and, if we may be allowed to use a somewhat familiar expression, it serves to *épater les bourgeois*; and we might designate M. Blanchart's method—The art of manipulating kilogrammes of minium so as to obtain fanciful—we repeat the term—results in kilogrammetres. There is, however, another step to be taken in this direction. We beg to be allowed, in conclusion, to point it out to M. Blanchart. Certain writers give 2·60 as the electromotive force of the secondary couple of plates of lead; let us accept this figure, which will be almost as accurate as admitting a constant electromotive force of 2·15 volts. We know, besides, from the electro chemical equivalents that a gramme of lead corresponds to 928 coulombs. The work developed by the chemical action, *i.e.*, the oxidising of a gramme of lead, corresponds, therefore, to:

$$\frac{928 \times 2{\cdot}6}{9{\cdot}81} = 246 \text{ kilogrammetres},$$

according to the laws of Joule and Faraday.

Reckoning, thus, 242,000 kilogrammetres per kilogramme of lead, and as we can also take into account the fact that the oxidising of a gramme of lead on one of the plates corresponds to the reduction of another gramme on the second plate, this result must be diminished by one half, and thus we can only reasonably expect to obtain 123,000 kilogrammetres per kilogramme of active material, according to M. Blanchart. Only we here find ourselves at the limit of acceptable hypotheses, and even of those that cannot be accepted; beyond this we have only to draw on our imagination. There is a French proverb to the effect that *quand on prend du galon, on n'en saurait trop prendre*. When we lay down hypotheses we cannot make too many, and this is what justifies the above figures, and which are still more fanciful than those of our courteous correspondent.

The moral of all this may be briefly expressed as follows: *The acceptation of a fact or a result should not rest on any mere hypothesis.* This is the origin, and the real cause, of our discussion with M. Blanchart. The public will judge between us.—[EDS. ELEC. REV.]

THE TELEPHONE.—We have received another letter on this matter from "Injustice," in which he says: "Your correspondent who signs himself as 'Justice' admits that he himself invented and put into quotation-marks, as a quotation from Mr. Justice Fry's judgment in a recent telephone suit, words which are not to be found therein; and he now defends this literary fraud!" The remainder of our correspondent's remarks we do not deem it necessary to publish, and we therefore trust that further correspondence on the subject may not be re-opened.—[EDS. ELEC. REV.]

D.S.—We do not think you can obtain the first edition of the book you refer to, unless you come across it at a bookstall.—[EDS. ELEC. REV.]

FAREHAM.—The matter you refer to has already been touched upon in Mr. Lowdon's letters to us.—[EDS. ELEC. REV.]

ON A NEW PROCESS FOR THE INSULATION OF ELECTRIC WIRES.—By M. H. Geoffroy.—Public attention having been much excited by various accidents due to the imperfect insulation of electric wires, I take the liberty of submitting to the Academy a new process, which seems to me to suppress radically all danger of fire, even when the wires are in contact with combustibles.

This process consists in covering the conductor wires with a packing of asbestos, and then placing them in a lead tube in the ordinary manner.

From experiments performed at Paris by M. H. Lippmann, engineer to the Faure Electric Accumulator Company, and which I am about to repeat, it results that a wire, like the sample accompanying this memoir, may be entirely dissipated without the spark being communicated outside. Though the experiment was performed with a powerful current on a short length of wire, where all the heat was, so to speak, condensed, the lead showed no trace of incipient fusion. The volatilisation is the affair of the tenth part of a second. The lead cannot melt, because as soon as the copper is burnt the current is interrupted.

Another experiment, very easily made, proves that the electric insulation is very satisfactory, and that no portion of the current is conducted away by the intervention of the asbestos.—*Comptes Rendus.*

[We have already briefly alluded to this in a former number of the ELECTRICAL REVIEW.]

OBITUARY.

GEORGES LECLANCHÉ.

ON the 14th of September, 1882, at 7 p.m., Georges Leclanché died at Paris, at the age of 43 years, a man universally well known and esteemed, the inventor of the peroxide of manganese battery. After leaving the Ecole Centrale des Arts et Manufactures de Paris, in 1860, Leclanché entered, as chemical engineer, the laboratory of the Compagnie des Chemins de Fer de l'Est, where he remained until 1867.

The year 1867 was the time of his first patent for peroxide of manganese batteries with a porous cell. He left the Compagnie to devote himself almost entirely to the industrial development of his idea, which he completed by a series of subsequent patents. Two of these new patents are especially important: that of 1873, relative to cylindrical agglomerate surrounding the carbon, and that of 1876, relative to movable agglomerate plates maintained against the carbon by india-rubber bands. Very limited at its commencement, the manufacture of Leclanché batteries is now almost monopolised at Paris by M. Barbier, employing 50 workmen, who manufacture at least 2,000 plates per day, and have turned out during the year 1881 about 280,000 elements.

At the present day complete elements or simply agglomerated plates manufactured at Paris are exported to all parts of the world. Leclanché batteries have penetrated everywhere; the recent invention of the telephone has given them a fresh impetus, and opened up an immense trade, of which the importance can scarcely at present be predicted; their increasing employment for domestic purposes, bells, calls, electric lamp-lighters, telephones, &c., has familiarised the public with electricity, and, to some extent, made way for more important applications. The capital invention of M. Leclanché will have been, therefore, at once a service and a benefit. His premature death in the full maturity of his intellectual power and of his chemical and electrical knowledge will be deeply regretted by all those who are interested in the progress and future of the applications of electricity.

Outside of his researches on batteries, which, to reduce them to a practical form, absorbed a large portion of his time, M. Leclanché was occupied with electric horology, and devised, to distribute the time to recording chronometers, a sure and ingenious system of simple contact, very little known, and applicable to a number of electrical instruments. We give a description of it in our other columns.

NOTES.

DYNAMO-ELECTRIC MACHINES.—We understand that the new machine of Sir William Thomson and Mr. Ferranti consists simply of a wavy or gridiron-shaped ring of copper revolving between two sets of electro-magnets. There is not, of course, any commutator, as in other machines, and the cost of construction is much reduced, as will be easily understood. It is stated that the experimental trials have shown that 12 (20 candle-power) incandescence lamps can be produced per horse-power. We take this in the ordinary acceptation of the term, and not as electrical horse-power developed in the lamps, otherwise the remarkable efficiency of the new machine would not be so manifest. It is further remarked that the Thomson-Ferranti machine is superior to that of "Brush" in the proportion of 12 to $3\frac{1}{4}$, or in other words, that the power required to produce 12 lamps of 20 candle-power each by the Brush system is, roughly speaking, about four times greater than that necessary to give the same result in the former. The electro-magnets of the new machine are intended to be excited from a separate source.

Mr. Robert Hammond, in writing to the *Times* on this subject, makes a very curious remark. He says: "Comparing a Ferranti machine of a given size and weight with one of any other system of the same size and weight, the new machine would *absorb* (the italics are our own) five times the horse-power and turn it into its equivalent of electric light, and it is therefore five times as efficient." Now, if a given machine absorbs *one horse-power* and gives out its equivalent in electric light—say, for example, 2,000 candles—and a similar machine absorbs *five horse-power* and gives out its equivalent as 10,000 candles, we cannot see the superior efficiency of the one. We may, however, have misunderstood Mr. Hammond's meaning, but he must not forget that there are already machines at work which will give a useful return in the external circuit of 60 per cent. of the engine horse-power expended upon them. One cannot be too careful in writing on scientific matters to journals chiefly read by the general public, who may be so easily misled.

A NEW ELECTRIC LIGHT COMPANY.—There was constituted at Sunderland on Monday last the North Eastern Electric Light and Power Association (Limited), with a capital of £100,000, in 20,000 shares of £5 each. Alderman Storey, M.P., presided at the preliminary meeting.

ELECTRIC LIGHTING.—At the half-yearly meeting of the shareholders of the North British Railway Company, held at Edinburgh last week, Mr. Roughead said he was one of those who advised the directors to try the electric light, and he wished to know the difference in cost between lighting up the Waverley station with the electric light and with gas.

Sir James Falshaw (the chairman), said there were two important stations, one in Edinburgh and one in Glasgow, illuminated by the electric light. The other day, when in Glasgow, he asked the station master if the light answered well, and was told that it was perfect. The electric lighting system in Edinburgh had been extended, and he thought they would find there was scarcely a better lighted station in the kingdom. As regarded the expense, there was little difference between the electric light and gas.

Mr. Roughead thought that when Edinburgh and other places had given up the electric light, it showed it was much more expensive than gas. He was quite satisfied with the light.

The Chairman: The arrangement is a temporary one, but if it proved successful in a year and a half, it might be permanently adopted. No one could find fault with a well-lighted station.

THE Town Council of Crieff at the last meeting decided to favour the introduction of the electric light. An abundant supply of water is available for motive-power.

A LETTER from the Brush Electric Light and Power Company brought this question again under the notice of the Montrose Town Council. These gentlemen are of opinion that it would be a very impolitic thing for them, notwithstanding the decision of Edinburgh and some other places, to refuse their consent to all the electric lighting companies, especially seeing that there would be no expenses to the corporation, who wished to supply the borough with electricity. They therefore intrust to the Lighting Committee the task of finding a company in whose application to the Board of Trade the council may concur.

WHEN the several requests for acquiescence of the local authority in applications about to be made to the Board of Trade came before the Inverness Town Council, that body resolved "that they reserve to themselves all privileges in connection with the lighting of the town, and further that they object to any company interfering with these privileges."

THE Police Commissioners of Helensburgh, having considered applications from two electric lighting companies, appointed a committee to collect information regarding the best mode of supplying the electric light to the burgh and to consider the whole subject.

THE gentleman who brought the application for supplying electricity to Bishop Auckland under the notice of the Local Board said he claimed for it the attention due to an important question, and which, having regard to the conflict between the board and the gas company, was at the present moment urgent. He showed that the town was suffering from the high price of gas, and the rigour with which the lighting power of the company was exercised. A special committee was appointed to investigate and report upon the question.

AFTER full consideration the Dundee Gas Commissioners instructed their clerk to inform the several companies who had preferred requests for permission to supply the towns with electricity, that the gas commissioners contemplated applying in next session of Parliament for a provisional order to secure the same object; and that they could be no parties to the companies obtaining the permission they sought.

THE deliverance of the civic powers of Scarborough is, "that it is undesirable, at present, to give consent to any application for a licence under the Electric Light Act, 1882."

A LETTER from the Hammond Electric Light Company has got as far north as Thurso (apparently before the Electric Lighting Act), for at the last meeting of the Town Council they instructed their clerk to get a copy, and meanwhile to ask the company what they would undertake to light the town for during the present season.

THE Arbroath Town Council have refused their consent to the applications of the Hammond, Brush, and Swan Companies, "because the electric light is still in its infancy, and it is difficult to say what the system might come to."

A SPECIAL meeting of the Dundee Gas Commissioners was called for Wednesday last, "for the purpose of resolving to apply to the Board of Trade, under the Electric Lighting Act, 1882, for a provisional order to authorise the commissioners to supply electricity for public and private purposes, as defined by the said act, or for some of those purposes, within the burgh of Dundee, or some part therein."

THE ELECTRIC LIGHT IN SPAIN.—The Anglo-Spanish Brush Electric Light and Power Company is making good progress in the Peninsula. The towns of San Sebastian and Irun are already lighted by their local authorities under contract with the Anglo-Spanish Brush Company, and so pleased are the authorities with the result that they have increased the number of lights very considerably. In England the electric lighting companies have to compete with gas at a cost of from 2s. to 5s. per 1,000 feet, while in Spain the price is from 12s. to 15s. per 1,000 feet. As many towns in Spain have no gas in consequence of the expense of erecting works and the cost of gas when produced, it is reasonable to suppose that ere long these towns will adopt the electric light when it can be supplied at moderate rates. It is said that a scheme for lighting the port and harbour of Bilbao, Spain, is now awaiting the sanction of the authorities. It provides for the establishment of 40 lights, each of 2,000 candle-power, supplied by two engines, and the work of construction is calculated to cost about 15,000 dollars, while the annual cost of maintenance is not expected to exceed £2,000.

KILLED BY ELECTRICITY.—A Reuter's telegram from Trieste, dated September 15, says:—"The hurricane which destroyed the nave of the pavilion of the exhibition also damaged the electric light apparatus. A man while engaged last night in repairing it accidentally received the full discharge of the current and was killed on the spot."

ELECTRIC LIGHT AMALGAMATION.—The *Financier* says:—There has been considerable inquiry, on American account, for Swan electric light shares, upon the strength of pending negotiations between that company and the Edison Electric Light Company for amalgamation, whereby they will virtually control the business of incandescent lighting. Accordingly, the shares of the Swan Electric Light Company, which are of £5 with £2 paid, possessing a capital of £1,000,000, issued this year, have advanced from $\frac{1}{8}$ to $\frac{1}{4}$ prem. As indicating the possibilities which exist in connection with the electric light market, it should be added that transactions have taken place in London in the £5 paid shares of the Edison Company (the capital of which has been privately placed in strong hands) at £15.

ELECTRIC LIGHT IN NEW ZEALAND.—It is proposed to introduce the electric light at Kaiapoi Wollen Factories; and as it has been found, says the *Christchurch Press*, that the power of the Company's engine is sufficient to drive a dynamo machine capable of furnishing the illuminating power for all the town lamps, it is thought highly probable that the municipal authorities may arrange with the company for the improved lighting of the borough in this way.

THE ELECTRIC LIGHT AT CLEETHORPES, LINCOLNSHIRE.—On Friday, the 15th inst., the Brush Midland Electric Light and Power Company, Limited, commenced their first instalment towards the lighting of Cleethorpes by the electric light. The place is to be illuminated partly by arc lights, and partly with Lane-Fox incandescent lamps. The arc lights were first used, and they have been continued each evening since, burning brilliantly and steadily. Numbers of persons from New Clee and Great Grimsby have been over to see the light and seem much delighted thereat.

The incandescent lamps will shortly be fixed, when we hope to give a description of the work, which is being carried out under the superintendence of Mr. S. Vyle, the company's electrician.

ELECTRIC LIGHT IN DUNDEE.—The directors of the Kinnaivel and Argyll Halls, Dundee, have accepted the offer of the Northern Electric Light and Power Company, to light their halls by electricity, the work to be done as soon as possible.

THE EDISON ELECTRIC LIGHT.—A decided improvement in the lighting of the Holborn Viaduct is now to be seen. The double lamps have been discarded for single ones of greatly increased brilliancy, and the general effect is very marked. This change will, however, probably necessitate more frequent renewals, now that the carbon filaments are worked to a higher candle-power.

THE GÜLCHER ELECTRIC LIGHT.—This system of electric lighting is attracting considerable attention at the Tynemouth Exhibition. We notice in the Shields *Daily Gazette*, that Swan's light was rather deficient, but the Gülcher, which is placed in the lower machinery shed and neighbouring sections, was a great success. *It was the finest display seen since the opening of the Exhibition.* The Hammond light was not, somehow, so good as it has been.

We also clip extracts from letters of Mr. Thompson's (see "Correspondence") Sunderland agent, to the following effect:—"The Gülcher light is the coming light, to my mind. It was amusing the other evening when we started; the place was all lit up by the other lights, and appeared as bright as day. We had only one of our lamps in this large section. We started, and the change was both literally and figuratively electrical. It was as though a great big sun had dropped in amongst us. The rest were immediately dwarfed into moon and stars, beginning with the Hammond Company as the moon. There was a rush to our stand, hitherto deserted, and the Gülcher lights are attracting no end of attention.

"Your lights are simply perfection—the others, even the great Hammond, are not in it. I feel quite proud of them. Up here they have dwarfed all the rest."

If the future of this system depended on the enthusiasm of its Tynemouth advocates its success would be certain, but when one arc lamp gives out a superior light to others the chances are that it is consuming proportionately more horse-power. However, we wish the Gülcher light may be met with the favour which it certainly deserves.

NEW CABLES.—It is rumoured that the Telegraph Construction and Maintenance Company has in course of manufacture a duplicate cable for Lisbon-Madeira, and a triplicate to be laid from Suez to Aden. We also hear that the company's s.s. *Kangaroo* is now off the works at Greenwich, shipping cable to connect Malta and Tripolis, and that she sails this week. News from Portugal informs us that a contract has been signed between the government and Mr. Braam for the laying down of a cable between Lisbon and the United States, touching at the Azores.

ANGLO-AMERICAN TELEGRAPH COMPANY'S CABLES.—We are informed that the Telegraph Construction and Maintenance Company's s.s. *Scotia* has succeeded in picking up the Anglo-American Telegraph Company's cable laid in 1869 between Brest and St. Pierre in mid-ocean, in depths varying

from 1,600 to 1,930 fathoms of water, and repairing the fault which occurred on the 18th March last. A minor fault has also been repaired at a distance of 335 miles from Brest, in a depth of 1,269 fathoms. The whole of the company's system of cables and land lines is now in perfect working order and condition.

TELEGRAMS FROM THE SEAT OF WAR.—The Eastern Telegraph Company notify that telegrams are being received at present from Cairo very irregularly, several days' messages having accumulated and apparently got out of order, causing delay in some cases of three and four days. The Egyptian Government announce that they are ready to transmit international telegrams to all stations in Egypt, but, in face of the irregularities referred to, the Eastern Company will accept messages at senders' risk only. The Eastern Company's own wires to Cairo and Suez are being rapidly restored.

THE STEAMSHIP "INTERNATIONAL." — The s.s. *International*, Captain W. F. Wardroper, left the Silvertown Telegraph Works for Greenhithe, on Wednesday evening, the 20th inst., and after having adjusted her compasses, she sailed from there for Soussa, Tunis, on Thursday afternoon, the 21st inst. The *International* carries some 300 nautical miles of cable, to be laid for the French Government along the coast of Tunis. from Soussa to Sphax, Sphax to Gabes, and from Gabes to the island of Djerba. Mr. Theophilus Smith is in charge of the expedition, and is assisted by Messrs. H. Benest, J. Rymer-Jones, J. W. A. Knox and others. The French Government is represented on board by Messrs. Rambaud and Schaeffer, Engineers in the French Telegraph Administration, and who superintended at the Silvertown works the making, testing, and shipping of the cables. On arrival at Soussa, Messrs. Durregne and de Nerville, of the French Telegraph Administration, will join the ship to witness the laying operations. At the special request of the French Minister of Posts and Telegraphs, Mr. Borel, son of the Directeur du Bureau International des Postes de Berne, accompanies the expedition.

CABLES AND CORAL FISHERS.—*L'Electricité* of the 16th inst. contains the following:—"One of the two English cables used for the Indo-China traffic, landing at the town of Bona, in Algiers, was cut on Tuesday last some twenty-two miles from shore. Coral fishers are most probably the cause of this accident. At the time that the cable broke the Bona office was receiving a message. Thanks to an apparatus of recent invention it is possible to calculate exactly where the place of the break is located. The cable will be picked up and repaired. Unfortunately, the two telegraph ships belonging to the Eastern Telegraph Company fitted out for this kind of work are at the present moment employed in laying a cable at Alexandria. The repairs of the Indo-China cable will, therefore, suffer some delay."

We know that the French Telegraph Administration in Algiers have had great trouble with the coral fishers at Bona, as they frequently fouled and damaged the French coast cables whilst fishing for coral off that port. The commandant of the harbour had them all called together to a meeting, and there told them that the most severe measures would be taken against them should they continue to interfere with the cables, as he was quite prepared to indemnify them for any losses they might suffer through fouling the cables.

CHINESE TELEGRAPHS.—We read in *Nature* of the 14th inst. the following:—We have received a letter from a gentleman in Hong-Kong, signing himself "Verax," referring to a note in our issue of June 1st (*see* ELECTRICAL REVIEW of June 10th) on the subject of the projected Chinese telegraph line between Hong-Kong and Canton, and the alleged refusal of the colonial authorities to permit the landing of the cable across Victoria Harbour on British territory. The facts as stated in our note he allows to be correct. But whatever the grounds—and "Verax" fails to show there are any substantial ones—for local opposition to the enterprise, we regard it as peculiarly unfortunate that any forward step of the Chinese should be retarded by the British authorities.

THE TELEPHONE CONVENTION IN BOSTON (AMERICA).—At the meeting of September the 6th, Mr. T. D. Lockwood, of the Committee on Cables and Subterranean Telegraphy, read a paper giving the results of experiments made with underground wires since the invention of telegraphy, and the disadvantages arising from that method of laying wires.

William F. Jackson, of Detroit, Mich., from the Committee on Telephonic Supplies, described at some length the different appliances used in telephony, but refrained from expressing an opinion as to their merits.

W. D. Sargeant, of Brooklyn, from the Committee on Electrical Disturbances, read a comprehensive paper treating of three subjects—leakage, induction, and earth and atmospheric currents—saying that the increasing number and length of wires prove the value of good insulation and conductivity. No loose or unsoldered joints should be tolerated on a telephone line. The great enemies to long lines are induction and retardation. The latter appears to be the most difficult to remove. In so-called anti-induction cables retardation is most manifest. When inductive shields entirely enclose the insulated conductor the metallic circuit appears to remove much of this trouble. A cable, the longest in this country, has been recently laid from Newark, N. J., to Jersey City, some ten miles. The conductors in this cable change their relative positions at every joint of about 1,000 feet, and the remedy seems to be effectual, conversation on a single grounded circuit being carried on without interference with others, and the sound of several Morse wires working from batteries and dynamos was scarcely audible. As to earth and atmospheric currents, it is believed that with well-insulated lines of non-magnetic material a degree of perfection may be attainable that will leave but little to be desired.

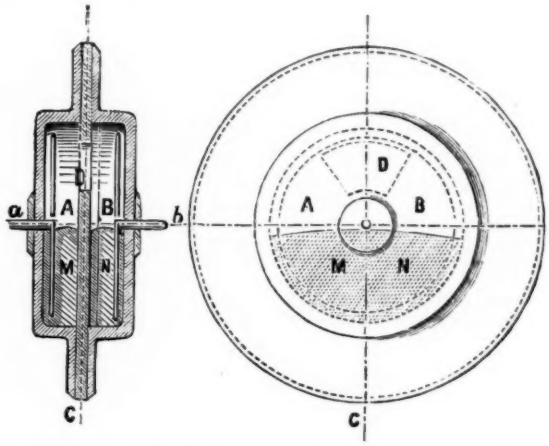
COVERED ELECTRICAL CONDUCTORS.—Apparently the wire-covering business is just now in a thriving condition. The Lea Telegraph Works, Hackney-Wick, the new factory of the well-known firm of Messrs. Phillips Brothers, is just completed, and the engine and shafting are being erected. The building will be lighted partly with arc lamps of the firm's own design, and partly with Edison incandescence lamps. At their old works, in Macintosh Lane, Homerton, an addition of 60 Edison lamps is to be made to the present installation, which we noticed some time since.

LIGHTNING CONDUCTORS.—A copy of rules for the erection of lightning conductors, based upon the recently published report of the Lightning Rod Conference has, with an explanatory circular, been issued by the Explosives Department of the Home Office, to the occupiers of all factories and magazines for explosives, and to those local and police authorities upon whom devolve the inspection of explosives. The rules deal with the material of the rods, their joints, curvature, fixing, &c., and the importance of periodical examination and testing.

PERSONAL.—Captain Shaw, chief of the London Fire Brigade, arrived in Montreal on the 31st August, where he was met by Alderman Hood, Chairman of the Fire Committee, and taken to the Windsor Hotel. In company with Alderman Hood he drove to the City Hall, and visited the central fire alarm telegraph station on the top of the building, where the system of alarms and the connection of the different stations on each circuit were fully explained to the visitors. Captain Shaw expressed himself as very much pleased with the system and apparatus.

ELECTRICAL ENGINEERING.—We beg to draw the attention of our readers to the following notice: Prof. W. Grylls Adams, F.R.S., will deliver a course of lectures on electricity at King's College, London, during the ensuing session. A course of practical work in electrical testing and measurement, with especial reference to electrical engineering, will also be carried on under his direction in the Wheatstone Laboratory. The lectures will be given once a week, on Thursday at 2 p.m., and the laboratory will be open daily (Saturday excepted) from 1 to 4. Fee, including both lectures and laboratory work, £8 8s. for one term, or £21 for three terms. The work will begin on Monday, October 9th, 1882. Further particulars may be obtained on direct application to Prof. Adams.

M. G. LECLANCHÉ'S MERCURIAL CONTACT.—When it is desired to impart the exact hour given by a standard clock to a series of receivers, the difficulty exists not in the receivers themselves, but in the establishment of electrical contacts perfectly good, equal in duration, without appreciable resistance, and rigorously equi-distant. If one contact lags, the repeating dial loses; if, on the contrary, the reverse takes place, the repeating dial gains. In order to obtain a good contact it is necessary to produce a metallic contact without oxidation, and without possible consumption of the metals. M. Leclanché solved the problem, first, by producing contact by the mixture of two liquid metals, in a hermetically closed vessel, and in the presence of an inoxidisable liquid or gas, thus protecting the metals destined to form the contact from atmospheric air; second, in only utilising from the standard clock the power required to operate a simple escapement, and in taking from a special source the power necessary for actuating the contact. The



apparatus represented above, of the natural size, is made up of a glass vessel divided into two chambers, A and B, by a vertical glass partition, C, perforated at the upper part by a hole, D. The chambers, A and B, are half filled with mercury, and also with a small quantity of protecting gas or liquid. The barrel is then hermetically sealed. By means of the tubes, *a*, *b*, the mercury in the two chambers can be put into communication, the circuit being completed by means of two platinum wires arranged in a circle in the interior of each chamber in such a way as to always keep in contact with the mercury during the rotation of the barrel.

By virtue of this arrangement, the barrel cannot complete a revolution without the aperture, D, becoming immersed in the mercury, and the two metallic pieces, which are ordinarily insulated by the partition, C, form a perfect electric contact between the two portions of mercury, M and N. When the revolution is completed, and the partition, C, again separates the mass of mercury into two parts, electrically insulated, a spark is indeed produced, but as it is produced in a closed vessel, and in a protecting medium, and consequently does not come in contact with the air, there can be no alteration of the metal; the spark produces a slight volatilisation of the mercury, which condenses in a pure state, to be again mixed with the principal mass, which is thus preserved indefinitely without any alteration. In practice, two openings, D, are arranged diametrically opposite, and producing a contact for each half revolution of the vessel..

The rotation of the barrel is obtained by an independent auxiliary spring; the standard clock has only to furnish the power necessary to actuate the escapements, each of which causes a rotary motion, and consequently the contact which results from it. This arrangement of mercury contact has furnished, in the hands of M. Leclanché, and his manufacturer, M. Barbier, an entirely regular progression of the receiving dials, absolutely corresponding to that of the standard clock, without gain or loss; a single standard clock allows of the regulation of an indefinite number of receivers. This system of contact is applicable to every description of apparatus founded upon successive electric contacts, repeated at regular or irregular intervals. The great certainty of its action induced us to give a description of it to our readers.

A STATUE TO ANTOINE CÉSAR BECQUEREL.—M. Edmond Becquerel, son of the eminent French *savant*, has informed the Académie des Sciences that the erection of the statue to his father, notified by the general council of the Loriet and the municipal council of Chatillon, the execution of which was intrusted to M. Guillaume, member of the Institute, by the committee appointed to receive the subcriptions, will take place on the 21st inst.

NEW COMPANIES REGISTERED.

DUCHY DUPLEX ELECTRIC LIGHT, POWER, AND STORAGE COMPANY (LIMITED).—Capital £50,000, in £1 shares. Objects: The business of an electric light and power company in all branches. Signatories (with one share each): W. J. Thomas, 81, Mildmay Park, N.; A. Harvey, Summerhill Road, Tottenham; A. Clegg, 13, Whately Road, East Dulwich; T. Williamson, 104, Elmore Street, N.; W. J. Twentyman, 264, Amherst Road, N.; Wm. Reynolds, Norbiton, Surrey; J. R. Rusden, Rye Lane, Peckham. The signatories are to nominate the first three directors, qualification, 100 shares; remuneration, £100 per annum to each director. Registered 13th inst., by E. Smith & Co., Abchurch Chambers, Abchurch Yard, E.C.

FERRANTI, THOMPSON, AND INCE (LIMITED).—Capital £240,000, in £5 shares. Office, 110, Cannon Street. Objects: To carry on business as electricians, and to purchase and work patents relating to electricity. Signatories (with one share each): *S. Z. de Ferranti, 24, Richmond Gardens; *A. Thompson, 8, Guildford Place, W.C.; *Francis Ince, St. Benet Chambers, Fenchurch Street; F. A. Holman, St. Benet Chambers; *J. W. Temple, 34, Leadenhall Street; R. Acock, Croydon; Robt. Hammond, 110, Cannon Street. Directing qualfication, 200 shares; remuneration, £1,000 per annum, and one-tenth of all profits available for distribution above the first £10 per cent. Registered 15th inst., by Ingledew, Ince & Co., St. Benet Chambers, Fenchurch Street.

LANCASHIRE MAXIM-WESTON ELECTRIC COMPANY (LIMITED).—Capital £100,000, in £1 shares. Objects: To light thoroughfares, streets, mines, ships, &c., in Lancashire, Cheshire, and North Wales with the electric light, and for such purposes to carry out an agreement of 16th inst. made with the Maxim-Weston Electric Company (Limited). Signatories (with one share each): J. T. Campbell and H. E. Hooper, 17, Warwick Street; H. Watt, J. B. Cox, F. Gerrard, and E. Gribble, 93, Leadenhall Street; C. J. Lewis, 5, Sugar Loaf Court, E.C. The directors are the Right-Hon. Earl De La Warr, Admiral Sir E. A. Inglefield, Messrs. John Roberts, M.P., Hugh Watts, and Thomas Whitworth. Directing qualification, 250 shares; remuneration, £1,000 per annum. Registered 19th inst., by Campbell, Reeves & Hooper, 17, Warwick Street, Regent Street.

* Signatories denoted by an asterisk are also directors.

OFFICIAL RETURNS OF ELECTRIC LIGHT COMPANIES.

THE following returns have been recently filed:

FAURE ELECTRIC ACCUMULATOR COMPANY (LIMITED).—The return of this company was filed on the 14th June, and is made up to 6th June. The nominal capital is £1,000,000, divided into 80,000 shares of £10 each, and 200,000 shares of £1 each. 27,628 of the £10 shares have been taken up, and £2 per share called up, and 50,000 of the £1 shares have been taken up and the full amount called thereupon. The total amount of calls paid is £105,236, leaving £20 unpaid.

EASTBOURNE ELECTRIC LIGHT COMPANY (LIMITED).—The return was filed on 28th June, and is made up to 27th June. The nominal capital is £50,000, in £10 shares. The number of shares allotted is 440, and £5 has been called up on each. The total amount of calls paid is £1,132 10s., and unpaid, £1,067 10s.

ELECTRIC LIGHTING CONTRACT AND MAINTENANCE COMPANY (LIMITED).—The return of this company was filed on the 14th ult., and is made up to the 7th ult. The nominal capital is £2,003,000, divided into 200,000 A and 300 B shares of £10 each. There have been 19,934 A and 300 B

shares taken up, and upon the former £2 per share has been called, and the latter are considered as fully paid up. The calls paid on the A shares amount to £39,915 5s., and unpaid, £2 15s. £50 has also been paid on 100 shares forfeited.

GENERAL ELECTRIC LIGHTING COMPANY (LIMITED).—The return of this company was filed on 22nd June, and made up to 13th June. The nominal capital is £50,000, in £1 shares, and 2,006 shares have been allotted, but no call has been made.

BRUSH ELECTRIC LIGHT AND POWER COMPANY OF SCOTLAND (LIMITED).—The return was filed on 7th inst. and is made up to 30th ult. The nominal capital is £300,000 in £5 shares. Upon 22,000 shares taken up £2 10s. has been called up and paid, and 8,000 shares have been issued as fully paid in part payment of concessions.

SOUTH EASTERN BRUSH ELECTRIC LIGHT AND POWER COMPANY, LIMITED.—The return was filed on 1st inst. and made up to 23rd ult. The nominal capital is £100,000, in £5 shares, the whole of which have been taken up. Upon 19,600 shares £1 10s. has been called, and the full amount upon the remaining shares. The total amount of calls paid is £31,300, leaving £100 unpaid.

NEW PATENTS—1882.

4366. "A joint for electrical lamps to be occasionally suspended and removed." W. R. WYNNE. Dated September 14.

4367. "Systems of electric lighting." W. MORGAN-BROWN. (Communicated by F. Schmidt.) Dated September 14.

4376. "Dynamo-electric machines." M. DEPREZ. Dated September 14.

4390. "Electric lamp holders." J. W. SWAN. Dated September 15.

4391. "Plates for secondary batteries." N. C. COOKSON. Dated September 15.

4404. "Electric lamps and apparatus for use in connection therewith, and for other purposes." H. H. LAKE. (Communicated by S. F. Van Choate.) Dated September 15.

4407. "Galvanic elements." J. H. JOHNSON. (Communicated by A. Bernstein.) *Complete.*

4412. "Locking points and signals by electricity." S. BREAR and A. HUDSON. Dated September 16.

4419. "Electric arc lamps." J. BROCKIE. Dated September 16.

4420. "Gaseliers, chandeliers, and electroliers, also applicable to the raising and lowering of other sliding appliances." M. MERICHENSKI. Dated September 16.

4421. "Telegraphic and telephonic apparatus." A. C. BROWN and H. A. C. SAUNDERS. Dated September 16.

4422. "Telephonic telegraphy and apparatus therefor." C. A. McEVOY and J. MATHIESON. Dated September 16.

4429. "Incandescent electric lamp globes." J. CROWDER. Dated September 18.

4431. "Improvements in secondary voltaic batteries, and in the manufacture of material and plates therefor." A. WATT. Dated September 18.

4434. "Galvanic batteries." S. H. EMMENS and S. MASON. Dated September 18.

4446. "Electrical meters." T. J. HANDFORD. (Communicated by T. A. Edison.) Dated September 19.

4450. "Porcelain and other insulators." W. E. LANGDON and J. C. and G. FULLER. Dated September 19.

4454. "Transmitters for speaking telephones." W. P. THOMPSON. (Communicated by G. F. Milliken, J. W. Brown, and H. D. Hyde.) Dated September 19.

4458. "Manufacture of carbon conductors for electric lamps." W. R. LAKE. (Communicated by E. Weston.) Dated September 19.

4460. "Batteries for generating electricity." G. G. SKRIVANOW. Dated September 19.

4461. "Dynamo-electric and magneto-electric machines." J. W. SWAN. Dated September 19.

ABSTRACTS OF PUBLISHED SPECIFICATIONS. 1882.

540. "Dynamo-electric and electro-dynamic machines." J. D. F. ANDREWS. Dated February 3. 6d. Relates to the construction and arrangement of dynamo-electric machines whereby mechanical power is converted into electricity, and of electro-dynamic machines by which electricity is converted into mechanical power, and to appliances for collecting and distributing the electricity in such machines, and for governing their motion. The inventor constructs the rotating armature in the following manner. On a length of flexible iron rope are wound transversely a number of coils of insulated wire. The rope so coiled is wound in a number of convolutions around a barrel of wood or other non-magnetic material, thus forming the coiled armature of the machine, which revolves between two opposite magnetic fields each extending over a considerable arc of the circumference. The wires of the several armature coils may be connected to a commutator of any known kind.

677. "Interlocking electric and other signalling apparatus." W. E. LANGDON. Dated February 11. 10d. The object of this invention is to provide an improved means of interlocking the electric and outdoor signals governing the traffic of railways and tramways so especially—first—it shall not be possible to place a starting or standard signal governing the departure of a given train or engine in the "all clear" position until the electric signal of such train has been placed in the "all clear" position; second—it shall not be possible to release an electric "line blocked" signal until the train for which the signal was set at "line blocked" has passed out of the section; third—it shall not be possible to release the block signal for, or to give the "all clear" signal to the section out of which the train has passed until it has been signalled forward to the next section in advance, and until the "line blocked" signal for that section has been received.

686. "Telephone call or signalling apparatus." A. M. CLARK. (A communication from abroad by G. M. Hopkins, of Brooklyn, America.) Dated February 11. 6d. The object of this invention is to provide a simple and effective call for telephone lines. The invention relates to the class of signalling apparatus employing magneto or induction currents in connection with polarised bell magnets.

687. "Telephone central office systems." A. M. CLARK. (A communication from abroad by G. M. Hopkins, of Brooklyn, America.) Dated February 11. 6d. Relates to switch boards for connecting two or more line wires at a central telephonic office and for signalling subscribers or users, and for ascertaining their wishes through the central office telephone. The invention consists in movable spring switch bars combined with movable tranverse rods having cam levers for establishing a connection between two or more of the switch bars, and at the same time removing the switch bars from the ground connection. It also consists in a system of central office combined polarised annunciators and relays for operating local circuits so as to move the transverse bars carrying cam levers to disengage the cam levers and place the switch board in its normal condition. It also consists in an arrangement of subscriber's switch and circuit whereby the subscriber may send either a positive or negative current over the line and through the polarised annunciator and relay so as to call the attendant at the central office, or operate the local circuit of the central office so as to return the switch board to its normal condition.

688. "Transmitting and repeating sounds by electricity, &c." A. M. CLARK. (A communication from abroad by G. M. Hopkins, of Brooklyn, America.) Dated February 11. 8d. Relates to transmitters of the description described in the number of the REVIEW for June 1st, 1880, and consists essentially in a contact surface attached to a vibratory diaphragm or other body capable of vibratory motion, and a floating electrode pressed against the contact surface by a column of liquid.

730. "Apparatus for measuring and registering electric currents." C. A. FAURE. Dated February 15. 6d. One of the principal objects of this invention is an instrument for permanently registering the amount of electricity that is passing in a conductor, so as to permit the easy reading off of this quantity after different periods of time as a gas meter is read. The principle upon which the instrument is based is well known, viz., that a conductor conveying a current tends to rotate around a magnet. In carrying the invention into practice the inventor employs a cylindrical electro-magnet mounted vertically within a vessel containing mercury, so that the electro-magnet is surrounded with mercury, a conductor in form like the flier of a spinning machine is pivotted on the top of the magnet core and its arms dip down into the mercury. The current to be measured is caused to circulate into the coils of the magnet and into the moving conductor, so that the moving force is proportional to the square of the current. The resisting medium is the mercury in the cup which for this purpose is made sufficiently deep. Now as the force required to move any object through a liquid is proportional to the square of the speed, it follows the number of rotations of the conductor will be proportional to the current to be measured.

740. "Electric lamps, &c." A. M. CLARK. (A communication from abroad, by the firm of Solignac and Company, of Paris.) Dated February 15. 6d. This invention, which is applicable both to electric lighting by the arc and by the imperfect contact system of incandescence, relates to improved means of regulating the feeding up of the carbon or carbons, and consists in making the approximation of the carbons dependent on the fusion or softening of a tube, stick, or other object of glass or other material capable of being fused, softened or consumed by the heat of the arc in such manner as to regulate the carbons in virtue of the relation which exists between the length of the arc and its temperature.

749. "Telephonic exchange systems and apparatus." G. L. ANDERS. Dated February 16. 8d. Relates to improvements in telephonic exchange systems and apparatus, and has reference to the construction and arrangement of the telephones themselves and their batteries, and the mode of using the same in telephonic exchange systems. According to the invention the inventor combines together a telephonic transmitter of the type hereinafter referred to, a telephonic receiver and a peculiar battery hereinafter described, in a portable case, capable of being held in the hand; the several apparatus, which form together the compound instrument, being arranged

normally in the proper position, relatively to each other, for action, and so that the sound waves shall act both upon the receiver and transmitter during the operation of transmitting, whereby a louder and clearer articulation is obtained. The transmitter employed is one of the type of what is known as Hunnings' transmitter, that is to say, one, the handling of which insures its adjustment. The invention divides the chamber or space for containing the powdered carbon or finely divided conducting material, in a loose and free state, into a series of separate compartments, whereby the tendency to a prejudicial accumulation of the said material in one place, when the apparatus is in use, is obviated. The transmitter may be conveniently constructed by the employment of a washer of felt or other suitable non-conducting material, perforated with, say, three holes; this washer is attached by an insulating ring to a metal plate, secured in the case of the compound instrument, and the holes being filled with the powdered carbon or finely divided conducting material, in a loose and free state, a thin diaphragm, composed wholly or partly of metal, is placed over the same, and secured at its edges to the insulating ring by a metal ring and screws. In front of the diaphragm is the mouth or ear piece of the telephone, and in the rear of the metal plate is an electro-magnetic receiver, whilst behind the latter is the peculiar battery next hereinafter described. The battery consists of a plate of carbon, covered with a salt of mercury, and of a zinc plate, which normally is held out of contact with the mercurial salt by means of a spring, a push button being provided in order to bring the two into contact when the apparatus is required for use. By means of the invention all the working parts are enclosed in a single instrument, which is self contained and portable, and brought within a conveniently small compass, so as to be capable of being held in the hand.

758. "Telegraph instrument." F. J. CHEESBROUGH. (A communication from abroad by W. A. Shaw, of Brooklyn, America.) Dated February 16. 6d. This invention consists of a telegraph instrument composed of stationary magnets, combined with a conductor having a vibrating section that is detached and swings freely in the main circuit and in the field of the magnet without breaking the circuit, and which is combined with a sounding device and operated by the action and reaction of a make and break current through the said vibrating section in the field of the magnets; and the said invention consists also of an electro-magnet combined electrically with the said vibrating conductor, and with a local circuit for the purpose of intensifying and quickening the motion of the sounding device.

761. "Dynamo-electric and magneto-electric machines." C. J. CHUBB. Dated February 16. 2d. This invention has for its object improvements in dynamo-electric and magneto-electric machines. The invention consists in causing the electro or permanent magnets of a dynamo or magneto-electric machine or machine for producing electricity to revolve in an opposite direction to the armature or series of bobbins or coils; the object being to increase the speed at which the coils or bobbins on the armature may pass the magnetic poles. The invention also consists in causing a conducting material connected magnetically with such magnets to revolve in an opposite direction to such armature, bobbins, or coils, or conducting materials as may be electrically connected with such bobbins or coils. (*Provisional only.*)

774. "Protecting wires or cables for conducting electricity." J. C. MEWBURN. (A communication from abroad by A. M. J. Jeune, of Paris.) Dated February 17. 2d. The invention consists in surrounding electric conducting wires and cables, after they have been insulated with ordinary insulating materials, or with "Chatterton" bands or strips, with a braided, plaited, or woven metallic covering. (*Provisional only.*)

821. "Electric telegraphs." C. N. TALBOT. Dated February 20. 6d. In many towns and cities, especially in the suburbs, there are dwellings and small manufactories that do not require messenger or telegraph facilities sufficiently often to make it worth while for each person to have a call box. The same is true in buildings containing offices, and under all such circumstances telegraph and messenger service would be a great convenience. The invention provides one signal box for the use of several persons, families, or business men, the same being located at a convenient place for the use of such parties, and provides means by which the person requiring the service will be indicated at the signal box, so that on the arrival of the messenger at the signal box he will be enabled to know who wants him or what is wanted.

2526. "Dynamo or magneto-electric machines." W. R. LAKE. (A communication from abroad by J. J. Wood, of Brooklyn, New York.) Dated May 27. 6d. The improvements are more especially applicable to the Gramme type of generator, or other dynamo or magneto-electric machine in which the coils or sections of the armature are connected in what is known as a "closed circuit," and the said invention consists essentially in an improved form of current regulator whereby the force of the current produced by the machine may be increased or decreased as may be required to suit the kind or amount of work which is to be performed by the machine; for instance, in electric lighting the current may be reduced to suit one lamp, or increased to suit any additional number of lights up to the maximum number capable of being maintained by the machine. To this end, the main feature of the invention may be stated to consist in the combination with a Gramme or equivalent form of armature and a movable brush holder, adapted to move the brushes on the commutator to the point of greatest effect towards the minimum position of a manipulating or adjusting device engaged with the brush holder, and with a catch or lock, and provided with fixed definite points of graduation and engagement, whereby the brushes can be set and held at certain indicated and fixed positions corresponding to distinct changes of current, suited for one or more lights without trouble or calculation on the part of the operator.

CITY NOTES.

OLD BROAD STREET.

EDISON'S INDIAN AND COLONIAL ELECTRIC COMPANY (LIMITED).

ON Thursday afternoon the first ordinary general meeting of the shareholders of the above-named company was held at the City Terminus Hotel, Cannon street, the Marquis of Tweeddale, chairman of the company, presiding.

Mr. J. Forwood Tafe, secretary, having read the notice convening the meeting,

The Chairman said: Gentlemen, you are no doubt aware that this meeting has been convened under a section of the Companies' Act which requires that a public meeting should be held within four months of the formation of the company. There is no report, and, of course, in the early life of the company, there are no accounts to submit, but I am here to give any information which may be desired with regard to the past or future of the company. The company was incorporated on the 13th June, and on the Monday following the applications for shares amounted to 24,482, which were fully allotted. The number was not quite so large as we had anticipated, more especially with regard to the interest that the public had before that time taken in similar enterprises; but we ascribe that falling off to the great attention which at that particular moment was being turned to affairs in the East, which very much disturbed the financial world and occupied the attention of the public in general. The object of the company was to acquire the patents and appliances which were the property of Mr. Edison, and which went to compose what is known as the Edison system of electric lighting. Mr. Edison, as probably every one present was aware, was a gentleman of high scientific attainments, who has devoted many years of his short but useful life towards developing electricity in several forms. One with which we are at present concerned is that which deals with both public and private lighting by electricity. No doubt there are many others in the same field, who have made very important advances in this subject, but no one—I think it is admitted by everybody—has done so much to render lighting by electricity practical and possible as has Mr. Edison. In fact, he has no rival in this so far as I am aware. You have only to look around you for proof of that fact, if you have any doubt. You have only to see what he has done on the Holborn Viaduct, where an area of this city is successfully lighted; and again go to the Post-office, which is lighted from the same centre, and there you will see another piece of successful lighting. A very large portion of New York is also at present being lighted by Mr. Edison's system. When you consider the space lighted in New York from a centre occupies a square mile, which would be, if in London, from about this spot to Charing Cross—that would be one side of the square—you may form some idea of the magnitude of this operation. There is another piece of important evidence on this matter, that amongst all the exhibitors at the general exhibition at the Crystal Palace Mr. Edison was the only one to secure the gold medal for a general system of electric lighting. It is that system of which we have become possessed through the medium of this company, and the object of the company is to give the benefit of it to India, Ceylon, South Africa, and the Australian Colonies. With a view to prosecuting our business we appointed Major Flood Page as our general manager, who occupied the position of general manager of the Crystal Palace for years. He is a gentleman of great energy, and I have no doubt will prove a most successful manager in the position he is now in. No sooner was the company formed than we entered into negotiations with different substantial parties from the colonies with a view to establishing bases of agreements for companies in those parts. I may mention, although it is not desirable to go into these details too fully, that we have entered into negotiations for the formation of a company in the Cape of Good Hope and two of the Australian colonies. At the Cape of Good Hope there is every reason to believe that the company will meet with success. One of the most important and successful of Mr. Edison's installations has been made at the Cape, where the Parliament House was lighted successfully about a year ago; and we have accounts from the Cape, showing how gratified the public are with this successful attempt to carry out electric lig hting there. Mr. Hortsek, who conducted the whole business of the installation at the Cape, is going out to Bombay with a similar installation from this company, to give the people of that place some idea of our system of electric lighting. Major Flood Page left England at the beginning of this month, intending to land at the Cape, and then to proceed to Australia to carry out the objects of the company, and your directors will be very much disappointed if, within a comparatively short time, they do not get some news of a favourable kind from Mr. Hortsek. So far with regard to the business of the company. With regard to electric lighting in general, if I were not a thorough believer in the electric light you would not see me here to-day. I am a firm believer in electric lighting, and I believe most firmly that it will be the light of the future. I think any one who has seen it—and I presume all you gentlemen have had opportunities of seeing it and forming an opinion—cannot doubt that it is the most perfect light that has ever been exhibited or attempted, as to its feasibility and its superiority in every particular over gas there comes the question of cost. This is at the very root of the whole thing, although electric lighting may be very good for persons and places, where it can be afforded, it can only be a general commercial success on the assumption that it is generally employed, and it can only be generally employed at a price similar to gas, or perhaps at a very little more. Now, gentlemen, holding this opinion, I turned my attention to results as to cost. The result of my inquiries was this, that I believe lighting by electricity will

compete successfully when established on a suitable scale with gas, even in England, and in countries where gas is as cheap as in England. This is the result of inquiries I have instituted for my own information, and you will bear this in mind, that gas is something over 3s. per 1,000 feet. If electric lighting can compete with gas, which is at something like 3s. for the 1,000 feet it is quite clear that it will compete successfully with gas where gas is much dearer. Gas at the Cape of Good Hope averages from 12s. 6d. to 15s. per 1,000 feet, and in the Colonies and in India the cost of gas is considerably in excess of the price in this country. Therefore if lighting by electricity is likely to pay in this country, it is all the more likely to pay in the Colonies, where gas is so much dearer. It is one of the advantages of the use of the electric light in the East that it causes a far less raising of the temperature than does the use of gas. Therefore one of the many advantages of the use of electricity is the fact that it reduces the temperature. In the Colonies and India the advantage of the light will be that it is one free from noxious vapours. Holding these opinions, that it is not only a good light, but that it is also an economical light, you will understand that we have entered into the company with the full belief that its operations will be attended with perfect success, and I look forward to meet you twelve months hence with a good and successful report of our proceedings during the year.

Mr. Campbell remarked that the chairman's statement that the cost of gas being much more was very important, but he thought, in order to get at the comparative or relative cost of gas and electricity, they wanted to know what there was in enhanced price for working the dynamo machines.

The Chairman said that coal was by far the largest item in the manufacture of gas, but it was comparatively a very small element in the production of electricity. Of course electricity would be more economical when water-power is obtainable.

Mr. Campbell: That does not apply to Australia, I doubt.

The Chairman: Well, I don't know that it does so much, but it does elsewhere.

No further questions being asked,

Colonel Gouraud proposed a vote of thanks to the chairman, which was seconded by Mr. J. E. Beves, and the chairman having very briefly responded, the proceedings terminated.

DIRECT SPANISH TELEGRAPH COMPANY (LIMITED).

THE report of the directors for the half-year ended June 30th, 1882, shows a balance to the credit of profit and loss of £5,889 12s. The receipts were £1,075 12s. 3d. in excess of those for any previous half-year since the formation of the company. The Bilbao cable was interrupted twenty days during last half-year, from April 30th to May 19th. The repairs were very promptly executed and the cable has since been in excellent working order. The cost of the repairs, £2,814 9s. 4d., has been paid out of the revenue of the half-year. The Marseilles-Barcelona cable remained in excellent working order throughout the half-year, and continues so. To meet a considerable accession of business, new offices have been engaged in Leadenhall Street, and will be ready for occupation shortly. The payment of the dividend on the preference shares absorbs £2,921 10s., leaving £2,968 2s., out of which it is proposed to declare a dividend of 3s. per share, free of income-tax, on the ordinary shares, and to add £800 to the reserve fund, which will then amount to £6,000, leaving a balance of £228 9s., which it is proposed to devote to the reduction of the preliminary expenses account.

SWAN ELECTRIC LIGHT COMPANY (LIMITED).

THE first statutory meeting of the above company was held in Cannon Street Hotel on Tuesday last, James Staats Forbes, Esq., presiding.

The Secretary having read the notice convening the meeting,

The Chairman said: Gentlemen, this is a statutory meeting. According to the articles of association, within four months of the launching of the company, the directors are to call the proprietors together, not for the purpose of submitting any report of accounts, but simply to conform to what appears to be somewhat of a technicality—probably as a means of introducing to gentlemen interested in these enterprises the outward and visible form of those persons to whom they have thought fit to intrust their interests. This is our first appearance before you as a board of directors. I should be very happy to go through the forms which prevail in polite society of introducing myself and the various other directors. First of all, Mr. Stevenson, M.P., of Newcastle, who has been very much mixed up in electrical affairs, being himself a scientific man; Mr. Batt, a highly-respectable London merchant; Mr. Villiers, director of a very important public company, whose name you will all know; Major-General Trevor, from India, a gentleman of great experience; and perhaps the most important of all, from some points of view, the distinguished inventor of our light, Mr. Swan himself. This is hardly the place, perhaps, to pay a tribute to a man of genius, but we have backed our opinion of Mr. Swan as a man of genius by our investments. He was to me an abstraction till very recently, but what I have had to do with him satisfies me that he possesses, not only the attributes of a man of genius, but also what is rare in such a combination, the attributes of a man of business as well. We are, also, fortunate in securing the services of another gentleman eminent in his way, Mr. Crompton. I need hardly tell you that whatever the confidence reposed in the board of directors who are a necessary adjunct to a representative institution like all joint-stock companies, the real essence of this concern lies in this: whether you have or have not done wisely in, so to speak, backing Mr. Swan and Mr. Crompton, because upon their knowledge and their devotion must ultimately depend the success of this company. Of course it is very early indeed to enlarge upon that topic. There has been a kind of electrical lighting—what shall I call it?—fever, as everybody knows. During the last few months a great many companies have been started, and a great number of predictions have been made. We believe that the Swan lamp is a sound practical thing with a great future. I think it would be almost useless to indulge in prophecy, because burnt bairns dread the fire. I have had to prophesy sometimes in other matters, and I find that if you prophesy right, it is all right, but if you prophesy wrong, you are terribly blamed. But as far as the observation of a non-scientific person and man of business goes, I think that anybody may satisfy himself by going to electrical exhibitions, by going to certain places where the new light is to be seen beside others, that whatever the merits or demerits of other inventions may be, the Swan is an excellent, practical, and beautiful lighting apparatus. You can see it, I think, as pleasantly as anywhere at the Savoy theatre. I do not know whether anybody has been there, but if not one would almost recommend them to go, not only to see the 500th and some odd representation of a very popular burlesque—"Patience" (laughter)—but to see how comparatively comfortable a theatre may be made by the instrumentality of the Swan, not only as affecting the vision, but in regard to the high temperature which often prevails in such places. Apart from the beautiful softness and soothing effect upon the eye, of the Swan, there is always a very low temperature in the theatre lit up by it. All that seems to point to this, that we are possessed of a means of producing a light applicable for any kind of thing—for street lighting if need be, for the lighting of great public buildings, for theatres and halls of every kind, manufactories, coal mines, and steamers. I have had a little to do with rather an interesting steamship just launched—the *Invicta*, which is to ply between Dover and Calais, and I assure you not the very least of her merits is that she is lighted by the Swan light, and a most admirable adjunct it is to a steamer. A great number of ships on some of the principal lines—the Orient line and the Union line—are being lit up, and an application of this light to almost every purpose ashore or afloat seems only a question of time. Since the formation of the company, four months ago, we have had a good deal of work to do. We bought the Swan Company as a going concern, and we also bought certain very valuable patents and had to take them over. We also made an arrangement with Mr. Crompton under which what are called installations, the machinery necessary for producing both the Swan light and the arc light in different places, had to be taken over in virtue of the purchase. That has been all done, and I can tell you that the factories in which these lamps are produced are in admirable working order. We found everything there that we had contracted to buy in proper condition. It has of course involved some little time making the transfer. We have had also to consider the extension of the business, and, without wishing to make any great flourish of trumpets, I may say generally that so far the progress of the concern has been very satisfactory. Of course it is a new thing. We had a great many difficulties to contend with, because a great many persons are competing for the public favour—the Brush, the Edison, and so forth. Whatever the differences may be between one invention and another, we feel that there is scope for the exercise of them all. The field is so wide that there ought to be no jealousy, no conflict. In fact, there is quite enough for everybody to do to carry out this wonderful and beautiful invention. I don't know whether you would like me to go much into details. First of all, the company is formed. Then, the various works have been taken over. We are, of course, not insensible to what is going on. We have had to watch with some care rather an important piece of legislation. It was not very politic or very wise to make any very great display, or to urge forward the business while Parliament was making up their minds as to what was to be the position of these companies in the future. They have only just practically concluded, within a very short time, a particular Act of Parliament which does regulate the position of such companies in the future with regard to the public service. The Board of Trade, happily, I think, took the initiative, which will probably prevent electric light companies from falling into some extravagances, such as, for instance, railway and gas companies fall into. They have laid down certain general principles as to the use of this electric light for public purposes, and we have waited very patiently, and developed our concern prudently and cautiously, as men of business ought to do. Of course we hope between now and our first business meeting to be enabled to produce a statement of capital account, and of working expenses and revenue, which would be more or less satisfactory. There was no reason to believe that it would not be entirely satisfactory. I would be almost inclined to warn you not to be carried away by believing that an enterprise of this sort will produce at first a very great or brilliant profit. One knows perfectly well that some of these companies have acquired very large sums of money by what they call selling their licences and their privileges to affiliated companies. This is a very legitimate source of profit, and one open to us as well as to them; but of course the real base of the prosperity of a company like this must be in the profit we realise upon our daily business—the difference, in fact, between what you receive in the sale of an article and what it cost you to produce it. As far as our experience goes, I think we have no reason to apprehend that there will not be such a difference between the cost of the production of our light and the price of its supply to the public as will leave a very fair, indeed a very good, interest upon your capital. We have not only bought the Swan light and the privileges attaching to its manufacture throughout the United Kingdom and the colonies, but also one or two other things. Every one has heard a good deal about Faure's accumulator, a remarkable invention, coming in aid of the electric light. Mr. Swan had some inventions in connection with accumulators, so had Mr. Sellon, of a very valuable kind. Just as with the lamp, there is a strong family resemblance between all these kinds of accumulators, and it is our good fortune to be in possession, through the agreements entered

into between Messrs. Swan and Sellon, and as part of the assignment to us, of the rights to an accumulator and the power to manufacture it, which will be of the greatest value to us as a company. I will merely indicate that as one source of profit. Any gentleman can see the practical application of such an accumulator on the Brighton Railway, where a train starting is supplied with a certain amount of electricity and is enabled to light itself during a long journey from one end to the other, at a price something within the cost of gas. This is an indication of what the system will enable us to do. All the railways in this country and in European countries will be lit, I feel satisfied, sooner or later with this charming electric light, and in that you see what an outlet for business there is. We possess the accumulator, and without it you cannot get the light into operation. The arc light has a great variety of names—one light has a little advantage this way and another that way—but all are generated by means which appear very simple now, and which are clear enough to the ordinary understanding. We have no antipathies, and no preferences, and no antagonisms. The rule we lay down for ourselves is, having a perfectly practicable and beautiful invention, to studiously find our way how to apply it on advantageous terms for the proprietors. I shall be glad as far as I can to answer questions of a general kind. If any gentleman wishes to ask any scientific questions, Mr. Swan is here to speak for himself; and if anybody wants to hear about dynamo machines and the different kinds of installations, Mr. Crompton will be happy to tell him. I do not think, however, I should sit down without adverting to one subject. You may have seen that some legal proceedings were instituted by the Edison Company against us for infringement. We are not very seriously alarmed on this side of the table about it. The Edison Company are a highly respectable body of people, with no doubt the invention of a very distinguished man. It is a very happy thing for us that we have an Edison in the one hemisphere and a Swan in the other to hit upon inventions which are allied in character though perhaps not the same in effect. We look upon that move of the Edison company as a mere political thing, but I don't think that seriously there can be any doubt as to the entire safety of Mr. Swan's invention. Everybody knows, as a matter of public notoriety, that long before Mr. Edison was heard of, Mr. Swan had actually lectured and exhibited lamps in England, and we apprehend no great difficulty with the Edison company, for this reason: the field is so enormously wide, that no particular body of men, or any particular inventor, can possibly hope to cover it, or to monopolise it for himself, and I think it very likely that we may see, in respect to the Edison and Swan companies, a similar arrangement to that which took place between the Edison and Bell company in the telephone. The two are almost identical. There was an electrical invention of marvellous ingenuity and enormous public value, and there were two inventors, one a Scotchman, Mr. Bell, and the other Mr. Edison. These two companies started in London, and there was talk of litigation on both sides, but the common-sense of the proprietors and directors induced them to do what was of exceeding advantage for both to do—to put their horses together and make common interest. I think something exceedingly like that may take place between the Edison and the Swan (hear, hear.) It is rather fortunate for us that some people connected with the Edison Lighting Company and some of the people connected with the Swan Lighting Company are also people connected with the Edison Telephone and the Bell Telephone. I have the honour of being the deputy-chairman of the Bell Telephone Company, and I am now the deputy chairman of the United Telephone Company, that having been formed by the union of the Edison and the Bell; and I think I may say it, not for the sake of vanity, but to illustrate my previous remark, that it was a good deal owing to me that the arrangement was brought about. The things are so absolutely analogous, the interests are so identical, that I think the same result may follow here. At all events, we do not at all intend to litigate; we would much prefer going on in an honourable, straightforward, gentlemanly competition with other competitors, being perfectly satisfied that all we can do to meet the growing wants of the public in this direction will tax our full powers. All that is very general. I cannot go into figures. I cannot say more than I have said, unless any proprietor will suggest something to me as to further information upon any point. I must sit down without having any resolution to propose or any accounts to submit. If any of my colleagues like to make any observations to the meeting, I am sure we shall be very glad to listen (hear, hear).

After a pause the Chairman said: As the spirit does not seem to move anybody, I shall merely say that we shall prosecute our business in the best shape we can, and having held this first statutory meeting according to our articles, in the course of eight months or so we shall have the pleasure of calling the proprietors together, and then submit to them in proper form the report and accounts of business, whatever it may be at that time. I think that when that time comes we shall be found to have made satisfactory progress. If not, it will not be for want of effort as far as this kind of invention is susceptible of being forwarded, or ability on the part of my excellent colleagues and coadjutors. I ought to have mentioned that there is one other gentleman in the room whose connection with our light ought not to be lost sight of—Mr. Stern, who has been associated with Mr. Swan in the perfecting of this most beautiful light, and to whom, I am sure, Mr. Swan would do full justice for assistance received. He conjoins the position of a man of business with a love and knowledge of abstract science so great that he has been enabled to be of inestimable aid to Mr. Swan himself in the perfection of this lamp. I think that Mr. Swan will be the first to accord to him a share of that inventive faculty, and that wonderfully patient power which has been necessary to develop what seems so simple a thing as a Swan lamp, which you can buy for 5s. (hear, hear). There is no other business except to say that we have fulfilled the statutory duty of calling you together and to thank you for your attendance.

The proceedings closed with a unanimous vote of thanks to the chairman for his able conduct in the chair.

THE DUPLEX ELECTRIC LIGHT, POWER, AND STORAGE COMPANY (LIMITED).

THE first ordinary general meeting of this company was held on Monday last at the offices, 9, Soho Square, Dr. Lilley in the chair.

The notice convening the meeting having been read by the Secretary,

The Chairman said the allotment of the shares took place at the end of May, and the "par" issue was restricted to £30,000. Since then 387 additional shares had been allotted at 10s. premium, thus realising a profit of £193 10s. Suitable premises for the Company's business had been taken on advantageous terms at 9, Soho Square. Arrangements had been made for the manufacture of the duplex incandescent lamp on a large scale, and the execution of the orders for considerable numbers was being proceeded with. The first duplex dynamo had been manufactured, and was now working, making most satisfactory progress. As regarded other duplex appliances good progress was being made, and the directors were satisfied that the company possessed a more complete electric system than any of its competitors. They were ready to adopt any invention of improved merit, provided that no terms were asked for beyond the payment of a moderate royalty, and the provision of proper guarantees for the working of the patents. They did not take up a position of competitive hostility with other companies, but were ready to take the executive orders for any of their systems that individual clients might prefer, the company's profits in such cases being the wholesale trade discounts allowed by the proprietors of the respective patents. Their operations thus covered the whole ground of electrical work, instead of being confined to the single business of lighting. Their general trading department was now in active operation, and already yielding satisfactory profits. They had also begun to take contracts for electric installations in various localities, and had been able to secure the services of a large number of influential local agents; in fact, they had on their books the offer of much more work than they could possibly execute pending the development of their manufacturing departments, and it would necessarily be some time before they could carry out operations on a large scale. He mentioned this to prevent disappointment in the case of shareholders and others desiring electric installations at short notice. These prospects had led the directors to regard with favour the establishment of sub-companies, and they were glad to report that the first of such associations was now an accomplished fact. It had taken the title of the Duchy Duplex Electric Light, Power, and Storage Company, and was to work this company's concessions for the counties of Devon and Cornwall. They had received a first payment of £1,000 in cash and £3,875 in shares for this concession, and were to be paid for their instalments until a total royalty equal to 2d. per head of the population had reached their hands. In addition, the Duchy Duplex had taken over their contracts for the erection of a battery of twenty Duplex mine lamps, with turbine dynamo-electric pumps, electric buddles, &c., and had paid them a cash premium of £500 for the same, while the further business to be done in Devon and Cornwall would lead to a constant demand by the sub-company for dynamos, lamps, and other appliances manufactured and dealt in by the company. Profits to date were as follows:—£193 10s., the premium on shares, £300 for the sale of a contract, and £123 11s. 5d. from miscellaneous sources, making a total of £623 11s. 5d. The concession receipts in cash and shares amounted to £4,875, bringing the total up to £5,692 1s. 5d., and it rested with the shareholders to determine what should be done with these profits. The directors recommended that a dividend at the rate of 10 per cent. per annum and a bonus at the rate of 2½ per cent. per annum should be paid in cash on the 30th inst. on all the cash paid up to that date. They also recommend that the board should be authorised to pay such interim quarterly dividends as they might deem advisable between the dates of the general meetings, and further that the sum of £11,000 (including the £3,875 Duchy Duplex shares) should be placed to reserve. Neither the directors nor the general manager had received any remuneration, and they left it to the meeting to say what would be a fair allowance for their labour. They trusted to receive the hearty support of every shareholder in rapidly building up a large and profitable business. In conclusion, the chairman moved a resolution embodying the recommendation of the directors in regard to the division of profits.

Mr. Holliday seconded the resolution.

Some discussion ensued, in the course of which

Dr. Emmens (the managing director) said, in reply to questions, that there was no doubt that within 12 months they would receive, half in cash and half in shares, no less than £175,000 for the English concessions, so that the shareholders would soon get their capital back, a large bonus, and still retain their interest in the undertaking. Arrangements had been made with two of the leading mines in Cornwall and Devon for the adoption of the company's patents.

The motion was then put and carried, after which a vote of thanks to the chairman and directors terminated the proceedings.

THE JABLOCHKOFF ELECTRIC LIGHT AND POWER COMPANY (LIMITED).

ON Friday, 15th inst., an extraordinary general meeting of the shareholders of the above-named company was held at the City Terminus Hotel, Jas. Wilson, Esq., C.E., presiding.

Mr. Francis R. Reeves, secretary, having read the notice convening the meeting,

The Chairman said: Gentlemen, one of the objects we have in calling you here to-day is to inform you that we have made application to the Stock Exchange for a special settlement of the shares of this company, and they proposed certain alterations in the articles of association. The directors consider that they are of a very unimportant character, and you will have no difficulty in agreeing to pass the

resolution at once. The first is to omit the article 16 altogether. The first part is already in article 13, and as to the last part, I presume the directors are bound to do their best to prevent registration of any fraudulent transfer. As the alterations are all in your favour, I don't think there will be any difficulty in agreeing to them. The second is to omit article 20 altogether. It is perfectly superfluous, and there will be no difficulty in omitting that. The third alteration is to omit clause 31 altogether, and it ought not to have been in the articles at all.

Mr. S. Simon: What is to be omitted? Will you read it?

The Chairman read the article, and remarked that the directors were bound, he took it, to prevent any fraudulent transfer.

Mr. Simon: If I had had the articles I would not have asked the question.

Mr. W. W. Lyndall asked whether the shareholders ought not all to have a copy of the articles.

The Chairman said they could have by paying 1s. for them.

Mr. W. W. Lyndall: By paying 1s. for them! Every shareholder, he thought, would not care to pay.

The Chairman said that was by Act of Parliament. Any shareholder can have the Articles of Association on payment of 1s.

Mr. Simon: By paying for it. They were ignorant of the articles. None of them had read those articles.

The Chairman: That is not our fault.

Mr. Lyndall said he was not blaming the chairman.

The Chairman said the notice gave what the meeting was called for. The alteration affecting the transfer of the shares merely threw more responsibility on to the directors. And the fourth alteration was to omit words from article 32, as of course they had no right to forfeit dividends.

Having read clause 20 at the request of a shareholder,

The Chairman said the last change was a proposal of their own, and arose from a printer's error; that was to leave out the word "meeting" between the words "such" and "to" in Article 48, and the insertion of the words, "business shall be given," instead thereof. And supposing these alterations were agreed to, the Stock Exchange would grant them a settlement at once, without waiting for the confirmatory meeting.

A shareholder said he thought such was contrary to the usual course.

The Chairman said that was what was understood, he believed.

Mr. Simon: You mean, they will give us a quotation.

The Chairman: Not a quotation; a settlement.

Mr. Davis remarked that he thought the articles were badly drawn that they should need alteration. Surely they knew the requirements of the Stock Exchange when the articles were drawn.

The Chairman said that, so far as his experience went, he hardly knew any set of articles drawn so as to entirely meet the requirements of the Stock Exchange Committee. Whether they were drawn properly or not the company wanted a special settlement, and the Stock Exchange said, "make these alterations first." He would put it to the meeting "That the Articles of Association be, and the same are hereby, altered as follows:—

"By the omission of articles 16, 20, and 31.

"By the omission of the following words 'and the dividends (if any) forfeited therewith' from article 32.

"By the omission of the word 'meeting' between the words 'such' and 'to' in article 48, and the insertion of the words 'business shall be given' instead thereof."

Mr. Simon seconded.

Mr. Steinthal asked if the chairman would tell him what was meant by a "special settlement" which they were applying for?

The Chairman replied that it was simply that the shares might be dealt with on the Stock Exchange.

The resolution was then put and carried unanimously.

The shareholders then resolved themselves into a general meeting, and

The Chairman said: Gentlemen, you are aware that this, our first or statutory meeting, which we are obliged by the Act to hold within four months of formation of the company; and in so short a time we have not done very much, and there is therefore not much to tell you. I may remind you that this company was formed with a nominal capital of £300,000, that we have been able to obtain from the general public, amounting in all to 400 shareholders, about one half of the capital, and that we found from the numerous demands we have for our lighting, we could employ the whole of our capital, supposing we were able to get it. As soon as the company was formed we took offices at the Winchester Buildings, at a moderate rental. We have appointed managers thoroughly acquainted with the enterprise we have started. I am glad to say we have numerous inquiries besides those of our regular customers, from harbour commissioners, docks, theatres, warehouse proprietors, and private dwellings. In fact, the demand upon us is so great that we have a difficulty at times in filling all the requirements made upon us. As you have seen, we have applied for a settlement, and now we have passed this resolution we shall be able to get one, and that will help us very much in our proceedings. We have also appointed canvassers, who are paid according to the results of their working, in various parts of London, as well as in the northern parts of England and in Scotland. We had to see what the requsitions of the Electric Lighting Bill would call upon us to perform; and those of you who have watched the progress of this bill, will know that this subject has given us great difficulty. We hardly knew what to do in the matter. We have made application to the vestries of London and other local authorities to give us permission to lay our wires in all parts; so we can supply anybody, as a gas or water company would supply gas or water. The Act specifies that before the Board of Trade will give us permission to lay the wires, we must first get the permission of the local authorities. I need not tell you that vested interests are strongly opposed in many cases to any improvement. We hope to get over that, and, in fact, we feel quite sure that electric science is not going to stand still for the sake of any vested interests—gas or otherwise. As to details of the business, you will excuse me if I do not give you too detailed an account. We have many competitive companies who are ready to do lighting almost for nothing, and therefore it would not do for me to tell you our means of defence and modes of operation. You must leave that information for a future time, and I hope we may have good results to show you. We are forming lighting centres in London, and we hope the next time we meet you to show you we are progressing in this respect. The Board of Works have prolonged our contract for lighting the Thames Embankment. They have given us permission to occupy a larger place on the Embankment, and have supplied us with drawings and details, so that we can have a larger engine-power there, and have a greater amount of electric light. We have taken a building on the Albert Embankment for the purpose of making our own candles. That forms the Jablochkoff electric light. Nothing can exceed the simplicity when compared with other electric lights. In all other electric lights there is machinery very complicated, and which must sooner or later get out of order. Others not having so much machinery, fall by gravity as the consumption goes on; but in the Jablochkoff it burns like a wax candle. Once lighted it continues to the end. In the Jablochkoff there is no machinery and no gravity. The consequence is its simplicity must in the future, as in the past, obtain much more custom. These candles are obtained the same as the French company obtained them from another company, which makes them in France, and a great profit is derived from their manufacture. They used to cost 7d. each, they now cost 2d., and they get a profit on that. We hope by making them ourselves to reduce the cost of manufacture and have an equal profit. In these premises on the Albert Embankment we purpose laying down small machinery, and hope to make the candles ourselves at a tremendous reduction on the present rate, and not only to supply our own customers, but also to supply the French company, who have to buy from other makers. The beauty of the light is this: there being no machinery attached to it, it can be worked a great distance with the greatest certainty. That at a mile's distance burns as certainly as one that is near. In all other lights where there is machinery, besides the profit they get in the installation of any new light, which we also get, they have the profit on the sale of a lamp; but once having sold that lamp there is an end to all their profit whatever. No profit comes to any of these other companies until a new lamp is required. In our case our profit arises from a daily consumption of these candles. This is a patent candle, and there is a daily profit from the consumption of it. I hope, therefore, that we shall supply all our customers and also perhaps the French company, who are willing to take their supplies at a less rate than they manufacture them at now. Since the formation of this company also Mr. Jablochkoff, who is a celebrated electrician, came over to this country with a new motor, which we have succeeded in securing from him after having consulted our electrician, Mr. Sabine, who said he thought it was one of the most wonderful things he had ever seen. This will drive any small machine by electricity, whether generated by steam or battery power. It is also in itself a generator of electricity, and can be constructed at such a very small sum, compared to the generality of dynamo machines, that we hope when once we have succeeded in getting this one from France, and making them ourselves, to supply electric light consumers with a dynamo machine at a very great reduction from what they pay now. More on this point I cannot say now, except that we have three of these machines in France, and hope to get them over shortly. Something has been said by various papers about a difficulty in using incandescent lights in conjunction with the Jablochkoff, and I am glad to tell you we have proved, and I have seen to-day, where a Maxim incandescent lamp has been used in conjunction, and mixed up, with the Jablochoff arc light, that they performed very well together, and I think the difficulty which has been prognosticated as to that is entirely at an end. I have nothing more to tell you than this, and I hope next time we meet you we shall have something good to report to you.

Mr. Sheridan, M.P., asked what steps had been taken towards manufacture.

The Chairman said they had taken the works on the Embankment, which is an admirable position, with a front facing the river, and the back the railway, having storage room behind, and were now entering into a contract for the different small works and machinery.

Mr. Simon inquired whether anybody else could make those candles? Had this company any licence to pay to any other?

The Chairman said they had no licence to pay at all; we have the sole right.

Mr. Lyndall said some suggestion had been made as to the probable sale of concessions by the company. Although the chairman said he did not wish to divulge too much of their business he should like to know whether anything in that way had been done, or whether there was any probability. He thought it would be satisfactory to the shareholders to know if that was the case, and was the amount required by the Stock Exchange to be subscribed sufficient?

The Chairman: Not for a quotation. We have about 400 shareholders holding 19,000 shares of the 40,000 offered for subscription.

Mr. Lyndall asked how much was required?

The Secretary said two-thirds.

M. Pratt inquired if there was any prospect of the electric light being used in the neighbourhood of the Strand or Covent Garden? He had premises there.

Mr. H. B. Sherridan, M.P., asked if the incandescent lamp could be used on the same wires economically?

The Chairman said, as to subsidiary companies a statement did appear in a paper, without their knowledge or consent, stating that they were forming subsidiary companies. There was an idea of forming sub-companies in the North of England and in Scotland, but the directors considered the time was not opportune. They would work the company quietly themselves. They might eventually grant small concessions, but not to large areas, or they would be taking

away the profits which this company might make. With reference to the Strand, they had made arrangements for lighting the Gaiety restaurant; they would shortly get their plant together and be able to light that and other places near. One of their largest shareholders was a gentleman who had used the light between two and three years, and as soon as that company was going to be formed he made application for £5,000 worth of shares. He had proved the light himself for several years. That gentleman had been induced to try at home various lights, but he, along with other customers, had come back to theirs as the best. As far as incandescent light was concerned, that gentleman thought there was nothing to compare with the Jablochkoff, and he had tried several other lights. An incandescent light had been applied in conjunction with the Jablochkoff on the same circuit, and there was perfect satisfaction with the result. These were facts, and not mere theories or ideas.

Mr. Simon asked if there was any profit showing to the company for the lighting of the Embankment.

The Chairman said he could not say much about that. We do not light it for nothing.

Mr. Simon: If you don't light it for anything, there has been a loss.

The Chairman said they had lighted one place for nothing; he did not mind telling them that. It was Charing Cross station. They did not mean to do that any longer.

Mr. Simon said if the company did not get anything for lighting the Embankment there was no advantage.

The Chairman said that the Embankment paid for itself. In the case of Charing Cross railway station, they had done the lighting for nothing, simply because the French company had done the same; but they had given notice to the District Railway that they did not intend to do so any longer, because they were out of the region of doubt, and wanted to be paid for their services. But they had offered to do it for the price which the company paid for gas, and if they were not inclined to pay that, they had given notice that the lights would be put out.

A shareholder said mention had been made of a prior company. What rights had this retained?

The Chairman said they had obtained their rights entirely for England and the colonies. They had the sole right in England and the colonies.

Mr. Terry said he saw no benefit by catechising the chairman in that fashion. They must have time to grow and develop their project. He thought, in the meantime, such questions should hardly be asked.

Mr. Scrutton said that it was the policy of the board not to grant concessions through the country and the provinces, but to employ agents, and make arrangements with private individuals, or with small districts, to take the light. He would like to throw out for consideration the fact that other companies were adopting a different policy, and occupying the ground as fast as they could. They might then find the ground preoccupied if they came to change their minds about granting concessions; and there was no doubt of one thing, that if they were to work from centres well divided, they would work with far greater energy in developing their company than if they were to work from a central office in London alone (hear, hear). If similar companies were formed in the provinces, with efficient directors, they would find it a means of bringing business to the board throughout the country.

Mr. Davis would like to ask what prospect they had of being in a position to apply for a quotation? Also if any promotion money had been paid, and if there was any objection to state what proportion to the present capital was held by the board. He should also like to know what the remuneration of the board was?

The Chairman said he would find that information, first in the prospectus; as to the prospects of the enterprise and as to the remuneration of the directors in the articles of association, which he could obtain for one shilling. As far as regards subsidiary companies, the question had their earnest consideration; and they would not stand still if they thought that the time was opportune, but after four months' experience, they felt quite certain that they must wait a little longer. If this company had been brought before the public one week before it was, they would without doubt have obtained the whole of their capital. But there came a revulsion of feeling. The public got mystified as to the conflicting lights, and suddenly the application ceased. He did not think that since that time there had been a moment in which they should properly attempt to form subsidiary companies. In all cases it would not do to fail, and they had no wish to throw upon the company any expenses at all. As to the auditor the directors would leave the appointment entirely in the hands of the shareholders.

Mr. Terry said, that if they could intrust the board with their money they could surely intrust them with the appointment of an auditor.

Mr. Taylor moved that Mr. Roderick Mackay, of Fletcher and Co., be appointed auditor. Mr. Lawrence seconded.

Mr. Burbage proposed as auditor Mr. John F. French, 26, Basinghall Street. Mr. Scrutton seconded.

Mr. Simon said that the names were unknown to the body of the shareholders, and he thought they had much better leave it in the hands of the directors.

Sir Joseph Mackenna, M.P., had come quite prepared to believe that the shareholders would have names ready; and, therefore, he for one had not thought over who would be a proper man for the auditorship. Their business on the board was to accept the shareholders' nomination; but in the absence of a unanimous selection he would propose for the post Mr. Charles F. Kemp.

The Secretary said he might mention that if gentlemen nominated would not serve, it would be the duty of the directors to call together an extraordinary general meeting to appoint an auditor who would serve.

The Chairman said that the best way would be to put the two names duly nominated to the meeting, and decide the question by the show of hands.

He would therefore put the names of Messrs. Mackay and French before them, and ask the supporters of each to hold up the right hand.

This having been done, the Chairman said he had to announce that the choice of the meeting had fallen on Mr. Mackay.

Mr. W. W. Lyndall said that a large number had not voted at all, knowing nothing about either candidate.

The Chairman said it was not the business of the board to mention any names. As to the remuneration, he might suggest that 25 guineas per annum might be voted (Agreed).

Mr. Marten said that he might point out that it was necessary to have a second meeting to confirm the resolutions passed at this one in about a fortnight. Therefore, if Mr. Mackay did not accept the office of auditor the matter could be gone into again at that time. If notice of the fact were given to the shareholders they would doubtless come prepared with the names of gentlemen who would accept.

On the motion of Mr. Terry, seconded by Mr. Pratt, a vote of thanks to the chairman was carried by acclamation, to which the chairman briefly responded, and the meeting terminated.

BIRMINGHAM AND WARWICKSHIRE BRUSH ELECTRIC LIGHT COMPANY.

THE first statutory meeting of the above company was held in Cannon Street Hotel, on Friday, the 15th inst., George Felton, Esq., presiding. There was not a large attendance of shareholders.

The Chairman said: Gentlemen, I am sorry there are not more shareholders present, but I think the hour of meeting has now arrived. I have to tell you that by our articles of association, and by the Act of Parliament, it is incumbent upon us to meet the shareholders within four months of the registration of the articles of association. We have done that upon this occasion, but like most of the electric light companies we have been unable to execute much business during the first three months. Indeed it has been our work to lay plans as far as possible for the future. Those plans, as far as I am able to do, I will place before you at the present meeting as frankly and as candidly as I know how to do. When this company was formed for Birmingham it found that it was necessary that we should have as far as possible the surrounding district, inasmuch as part of the borough of Birmingham—Birmingham having grown like most other places—was not in the county of Warwickshire. Just about that time an opportunity occurred of purchasing a concession of the Stafford and Worcestershire company. We did so at a cost of £26,000, first consulting our solicitors as to whether we had the power to do so. At the time that was considered a very good bargain. I still think myself, and my co-directors, I believe, agree with me, that it was a very good bargain, inasmuch as, in Staffordshire particularly, we shall have a large mining business. When the Worcestershire concession was turned over to us, a contract, entered into by Mr. Hammond, for lighting the Worcester exhibition, that we considered would be an opportunity for us to advertise the light in that particular district, and we therefore took it over. We are now lighting the Worcester exhibition, and have been for some two months; the whole contract is for four months. The directors of that exhibition have since then given us an order for lighting a horticultural exhibition, so that they appear to be well satisfied with the lamp in the district. In addition to that we have had a large firm in the neighbourhood of Birmingham applying to us for our system of electric lighting. They have been to Worcester, and the manager has expressed himself satisfied with the light such as he saw it at the exhibition. The agreement I was in hopes to have placed before you to-day signed, but it appears that the legal gentleman connected with their firm of solicitors being absent on his holiday, we have been unable to get it signed, but I have here a letter from the manager, which I will read to you. "Dear Sirs,—Your offer was duly considered by my directors at their meeting yesterday, and I am desired to inform you that they are willing to accept your terms if the light will be ready for use in the first week of October. They consider the agreement satisfactory, subject to the approval of our solicitors, and it will be signed probably early next week." We received another letter from him stating that the whole matter is settled subject to the advice of their solicitors. In addition to that we have had negotiations with Coventry and with Burton-on-Trent, with Rugby, and one or two other towns in our district—in Kidderminster particularly. In Kidderminster it so happens that there are three are four streets that are worth lighting, and the Council determined that the remainder of the town should be only lit by gas. The gas company, however, determined that unless the Town Council would give them the whole of the lighting, they would not light the sub-streets alone. Therefore the matter fell through for the present, the contract being renewed for one year only. With regard to Burton-on-Trent, the Town Council have obtained an Act of Parliament enabling them to put up the electric light in the town themselves. We are, however, in communication and negotiation with them, and we hope, indeed I think there is every probability that we shall be the contractors for carrying that out, and if so it would be as remunerative to us as if we put up the lights ourselves. Taking all these matters into consideration, I think that we have done as much as could be expected in three months. (Hear, hear.) We are actually lighting the Worcester exhibition, and we have done it for two months. We have already settled with one of the largest factories near Birmingham for the lighting of their premises, and we are in negotiations for four or five large towns in our district. Therefore I think you may come to the conclusion that the directors and managers have not been idle during the existence of the company.

With regard to the future, there is no doubt about this, that when this company was started, as was said the other day, it was on the crest of a very high wave. Things looked well, while they do not look so well now, according to the records in the newspapers. For

my own part, I believe there is a future for electric lighting. I have had opportunities of seeing electric lighting under very nearly every circumstance. I have had, also, opportunities of seeing nearly every system of electric lighting, and I have come to the conclusion that our own is as good, or, perhaps, better than any other, for street lighting particularly; and we are now putting up an incandescent lamp for house lighting, that, I believe, will be as good as the large arc lamp for outdoors. It is very difficult indeed to say what will be the profit upon electric lighting. We hear chairmen of gas companies get up and tell us that it is impossible that the electric light can ever compete with gas in the matter of price. Well, now, in opposition to that, we have a right, I think, to take into consideration the statements made by those people who are working the electric light themselves. There are private individuals—not companies—who have come to the conclusion that they can get very much better and purer light from the electric light, at a cheaper cost, than they could from gas light. It is cheerful, I think, when we look to the report of Lieutenant-Colonel Festing, the director of the South Kensington Exhibition, who has put the whole matter to the test for 12 months. He has had a machine put up, and has contrasted the price that it has cost during the 12 months with that of gas. We know the electric light, too, is very far superior for fine art exhibitions. We know the deteriorating effects of gas upon valuable paintings; indeed, in some galleries the owners refuse to allow gas to be used. Now, we find that Lieut. Col. Festing saves something like £725 in lighting the South Kensington Exhibition. Here we have an independent testimony, outside electric companies, outside gas companies, outside any influence that could possibly be brought to bear upon a gentleman occupying the position of Lieut.-Col. Festing; and I say that is the most cheerful thing that we, as electric light shareholders, have seen for a long time. I know, myself, one or two private firms who use the electric light, and are doing it at a less cost than gas. It is on these facts that we rely for our future, and not on the reports of gas companies and of gas shareholders. It is when the light is put up independently by private parties, where there is no bias whatever—where they want a good light for the purposes of their business, and find that they can get it at a less cost than gas, that we have a good test of its value. I don't know that I have anything to add to what I have said. I have told you where we have been and what we are doing, and what I think our future may, or should be.

Dr. Mackenzie asked where the Brush system could be seen in operation.

The Chairman said that they might see the light any evening at the Promenade Concerts, Covent Garden, and at the Great Western Railway Station, Paddington.

Mr. Howell inquired what amount of shares had been subscribed for.

The Chairman said that the number of shares issued amounted to £75,682.

A shareholder said that they were acting under a concession from the Hammond Company, and he had been struck by a paragraph in the City article of the *Standard* that morning in which Mr. Hammond informed them of a new invention designed to work not in connection with the Brush system, but in lieu thereof. Had the engineer any information with regard to that new invention?

The Chairman would ask Mr. Hammond to answer the question.

Mr. Hammond said that irrespective of the holding of the Hammond Company he privately held a large number of shares in this company—some 2,000—so that to that extent he was personally interested with its prospects. But he would look out purely from the point of view of the Hammond Company. It was quite true, as pointed out by the gentleman, that the concessions held were held from the Hammond Company and had reference particularly to the Brush machine and the Lane-Fox incandescent lamps. They had always, however, felt that having started sub-companies in any particular district, and got together an organisation for working their agencies there, that it would be to the interests of the Hammond Company to supply the sub-companies with anything whatever that the Hammond Company might afterwards obtain. They were really not under covenant to do it, but they had considered the matter pretty carefully, and they had decided that the fortunes of the Birmingham and Warwickshire Company should be bound up with those of the Hammond Company. He was glad to say with regard to the new invention mentioned, that it was one which would place at the disposal of the company in its patented district, where it reigned supreme, an amount of electric lighting that not till within the last few weeks was hardly dreamed of. He was hardly at liberty at the present moment to give closer details with regard to the machine; but when he told them that it was the joint production of Sir William Thomson and Mr. Ferranti, they would understand how very important it was likely to become. That machine, for incandescent house-to-house lighting, would light something like five times as much as any machine at present in existence. They would see what an important step had been taken towards making house-to-house lighting possible at the same price as gas, and indeed at a very good profit then. He might add that applications were made to the local authority on behalf of this company by the Hammond Company free of cost, because they felt that that work being at their fingers' ends could be better done in that way. They were actively engaged in making the necessary applications under the Act, and it would not cost this company one penny. This being settled, they would be able with the machine which the Hammond Company would hold to compete in the most satisfactory manner possible with gas, and he looked forward to the company's becoming one of the soundest in existence (hear, hear).

On the motion of Mr. Soliagne, seconded by Mr. Postlethwaite, a vote of thanks to the chairman for his conduct in the chair was carried by acclamation.

The Chairman briefly responded, and then called upon the secretary to read the notice convening a subsequent extraordinary meeting, the object of which was stated to be to consider a resolution to alter the Articles of Association as follows:—

1. To cancel clause 40.
2. To omit from clause 41 the words from "the person entitled to the share" to "as the case may be."
3. To omit from clause 112 the words "or otherwise interested."

The Chairman said: The necessity for these alterations arises from our application to the Stock Exchange for quotation and settlement. I believe in very nearly every case these particular clauses have had to be altered, and clause 40 expunged, in consequence of some clerical error. We have consulted our solicitor, Mr. Ince, and he tells us that it is merely a verbal alteration, but to acquire a quotation and a settlement on the Stock Exchange, which is so necessary to the existence of this company, we are compelled to make this alteration. I therefore hope some gentleman will move the adoption of the resolution for these changes.

Dr. Mackenzie, seconded by Mr. Thorp, then proposed the resolution for the alterations suggested. The motion was carried unanimously, and the proceedings terminated.

THE EASTERN EXTENSION, AUSTRALASIA, AND CHINA TELEGRAPH COMPANY, LIMITED, notify that they have declared an interim dividend for the quarter ended June 30th of 2s. 6d. per share, or at the rate of 5 per cent. per annum, together with a bonus of 1s. per share, both free of income-tax, payable on the 14th of October next.

APPLICATIONS have been made to the Committee of the London Stock Exchange to appoint a settling day and allow quotations in the following securities:—Jablochkoff Electric Light and Power Company, Limited, shares (settling day only), and Metropolitan (Brush) Electric Light and Power Company, Limited, shares.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations. Sept. 20.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	11¼-11½	11½-¾-¼-11-½
		Do. Do.	10	24 - 28	26½
30,000	5	Australasian Electric Light, Power & Storage Co.	3	1½- 2	
24,900	10	British Insulite Co., Limited, "A" Shares	5	4½- 5	
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	1 - 1½	
25,000	5	Great Western Electric Light & Power Co.	2½	⅞- 1⅛	
24,980	5	Hammond Electric Light & Power Supply Co.	2½	8¾- 9¼	8¾-¾-13-9-⅛-¼-⅛-⅜
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	1½- 2	
172,500	1	Maxim-Weston Electric Light and Power Co.	1	⅝- ¾	⅞
40,000	5	Pilsen, Joel & General Electric Light Co.	2	1⅝- 2¼	
..	..	South African Brush Electric Light & Power Co.	2½	¾- 1	
100,000	5	Swan United Electric Light Co., Limited	2	2¼- 2⅜	2⅞-⅛-⅜-⅛-⅛-⅜-⅛
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	51 - 52	
2,441,800*l.*	Stk.	Do. Preferred (Def'd. receiving no div. until)	100	82½ 83½	82¾.3½
2,441,800*l.*	Stk.	Do. Deferred (6 p. c. has been paid to Pref.)	100	20½- 21	
130,000	10	Brazilian Submarine, Limited	10	11½- 12¾	
16,000	10	Cuba, Limited	10	9½- 10½	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
13,000	10	Direct Spanish, Limited	9	6½- 7	
6,000	10	Do. 10 per cent. Preference	10	15½- 16½	15⅝
65,000	20	Direct United States Cable, Limited, 1877	20	11½- 12	11⅝
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	101 -104	
380,000	10	Eastern, Limited	10	10⅝- 11¼	11
70,000	10	Do. 6 per cent. Preference	10	13 - 13½	
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	100 -105	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101 -105	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	100 -105	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11⅜- 11⅝	11⅜.½
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	105 -110	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	102 -105	
140,000	100	Do. do. registered, repayable 1900	100	102 -105	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	102 -105	
254,300*l.*	100	Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan. 1900	100	101 -104	
345,700*l.*	100	Do. do. do. To Bearer	100	101 -104	
22,050	10	German Union Telegraph and Trust, Limited	10	9½- 10½	
163,390	10	Globe Telegraph and Trust, Limited	10	6¼- 6⅝	6⅜.⅛
163,209	10	Do. 6 per cent. Preference	10	12½- 12⅝	12⅝.⅜
125,000	10	Great Northern	10	12½- 12⅝	
100,000*l.*	100	Do. 5 per cent. Debentures	100	100 -103	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	26½- 27½	
100,000	100	Do. 6 per cent. Debentures, 1886	100	101 -105	
17,000	25	Indo-European, Limited	25	29½- 30½	
38,148	10	London Platino-Brazilian, Limited	10	4½- 5	
12,060	10	Mediterranean Extension, Limited	10	1½- 2½	xd.
8,200	10	Do. 5 per cent. Preference	10	8 - 9	
9,000	8	Reuter's, Limited	8	12½- 13½	
280,000	Stk.	Submarine	100	255 -265	
58,225	1	Do. Scrip	1	2⅜- 2⅝	
4,200	Cert.	Submarine Cables Trust	100	100 -105	
37,350	12	Telegraph Construction and Maintenance	12	30 - 31	
150,000	100	Do. 6 per cent. Bonds, 1884	100	102 -104	
186,750	5	Do. 2nd Bonus Trust Cert.	5	1½- 1⅝	
30,000	10	West Coast of America, Limited	10	4½- 5½	
150,000	100	Do. 8 per cent. Debentures	..	.. ..	
69,910	20	Western and Brazilian, Limited	20	6¾- 7¼	6⅞.⅛
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	104 -107	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80. red. Feb., 1910	100	97 -100	
1,500	$1,000	Western Union of U. S. 7 p.c.1 Mort.(Building) Bds.	$1,000	123 -128	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	100 -103	
88,321	10	West India and Panama, Limited	10	1¾- 2	1⅞.⅛
34,563	10	Do. 6 per cent. 1st Preference	10	8½- 9	8⅝.⅜
4,669	10	Do. 6 do. 2nd do.	10	7¼- 7¾	7⅜.⅜
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1½- 1⅝	1½
200,000	1	Oriental Telephone Co., Nos. 100,000 to 300,000	½	⅞- 1	⅜
100,000	5	United Telephone Co.	5	10¼- 10½	